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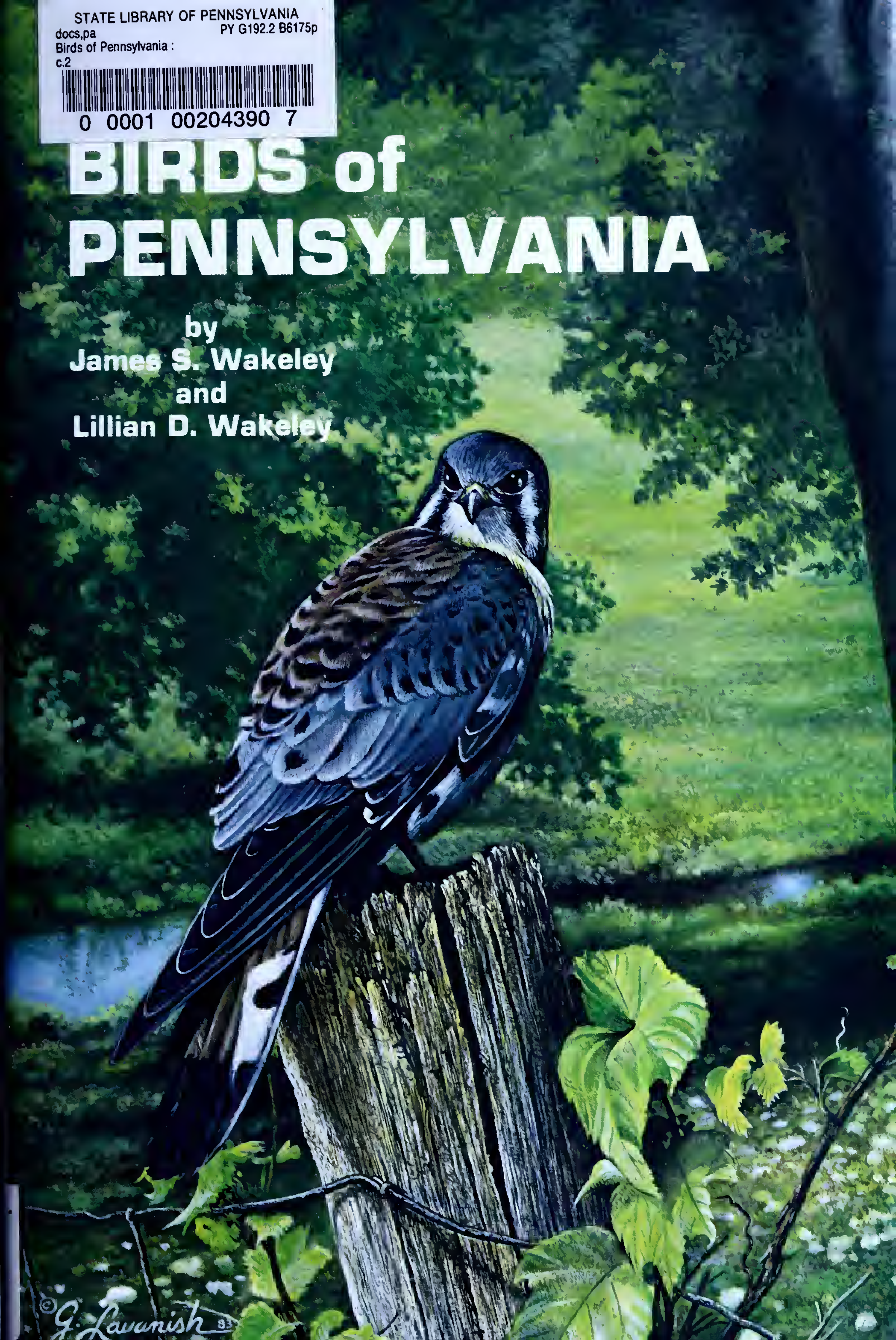
BIRDS of PENNSYLVANIA

by
James S. Wakeley
and
Lillian D. Wakeley



B. J. Wilt

THE AUTHORS

Authors Jim and Lil Wakeley enjoy Pennsylvania's birdlife from their home in State College. Jim's studies of birds are professional as well as recreational. He is Associate Professor of Wildlife Ecology at The Pennsylvania State University, where his teaching and research focus on habitat needs of both game and nongame birds. Lil is a geologist at Penn State's Materials Research Laboratory. She combines expertise in science and education in her writing about scientific subjects for non-scientists, and the place of science in society.

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BIRDS of PENNSYLVANIA

NATURAL HISTORY AND CONSERVATION

BIRDS of PENNSYLVANIA

NATURAL HISTORY AND CONSERVATION

by
James S. Wakeley
and
Lillian D. Wakeley

Black and White Illustrations
by
George Lavanish

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To our parents,
who took us outdoors

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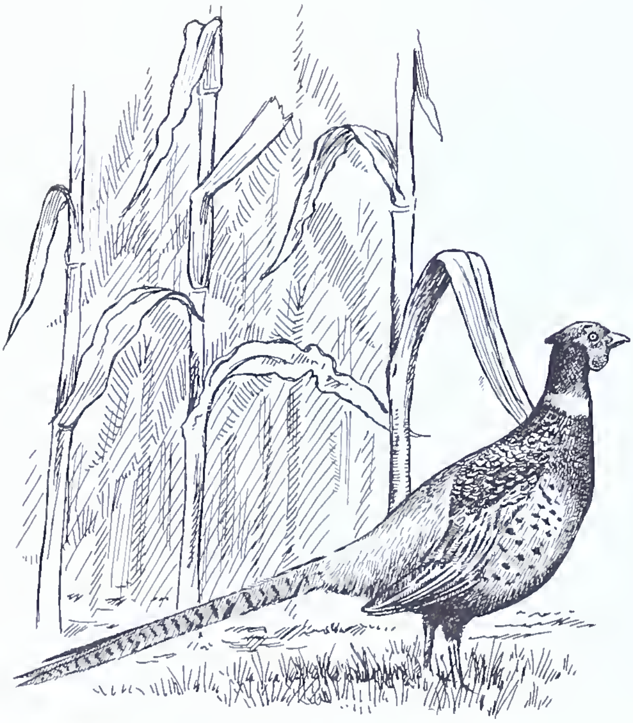

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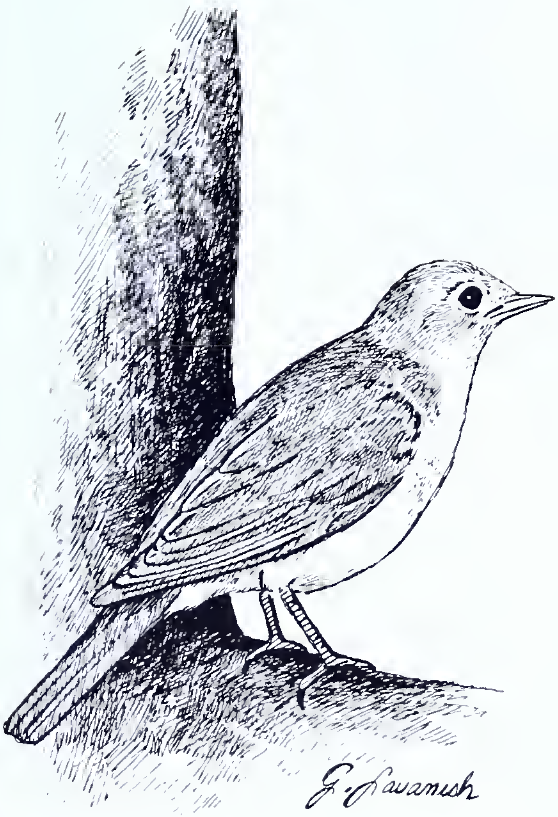
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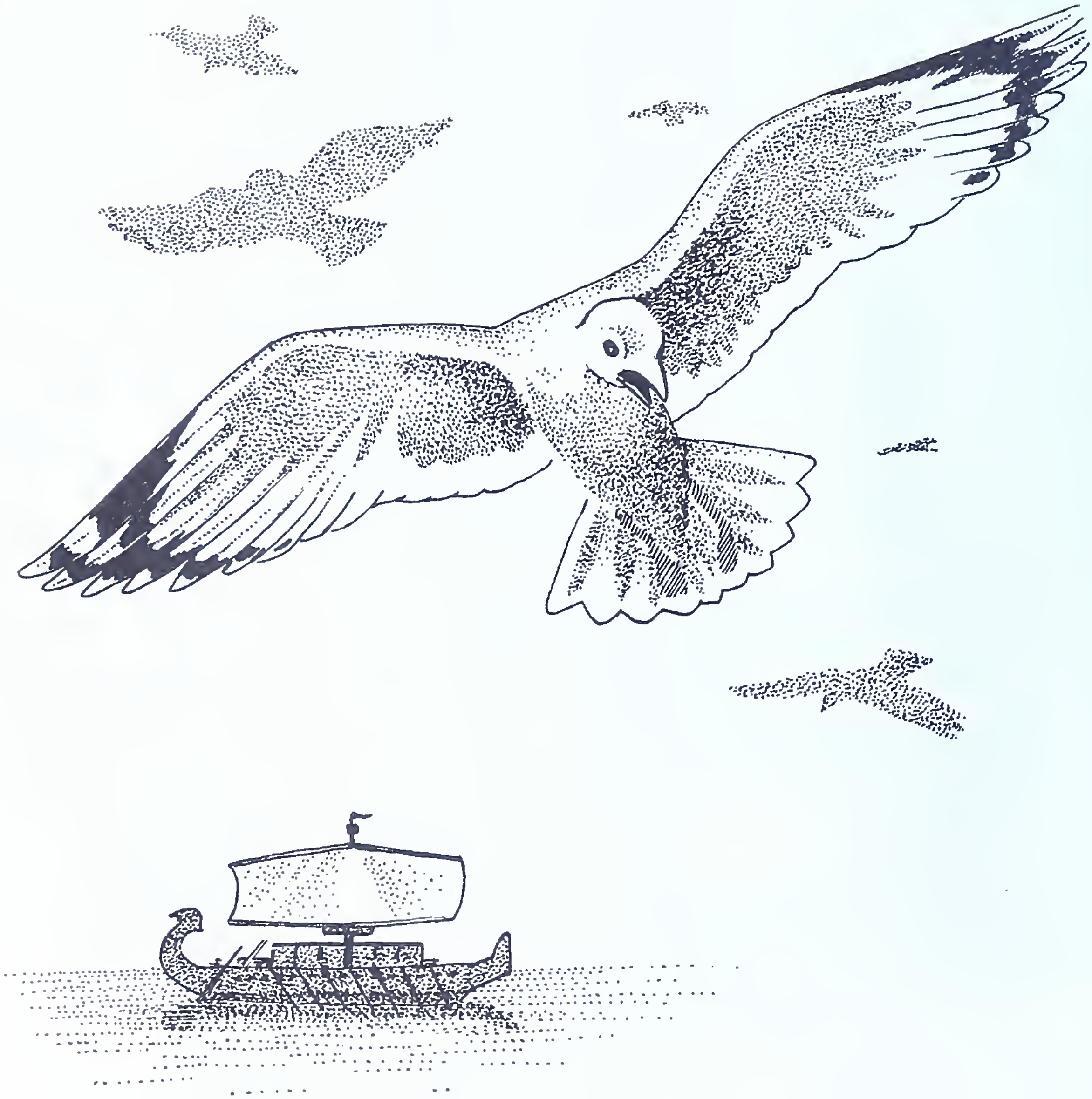


INTRODUCTION

For thousands of years, people have been in awe of birds. Ancient civilizations worshipped them as gods, or attributed magical powers to birds in their stories and traditions. The reason was simple—birds could fly. These beautiful, graceful, and highly visible creatures had the power of unlimited mobility. Different birds could ascend to the heavens, or dive to great unknown depths. They could disappear and reappear at will, with the change of seasons. Amazingly vocal, adaptable both to the wilds and to the ways of man, birds certainly seemed to possess mystical powers.

Because they are so numerous, birds have been a subject of study since the time of the ancient Greeks. Some species, it was discovered, could be tamed and raised domestically. Others made good pets, or could be trained for falconry. Birds were seen as basically good creatures. Unlike snakes, sharks, and lions, no birds were known to be poisonous or in any way threatening to humans. As mankind became agrarian, the benevolent birds seemed to adapt with him, always visible, beautiful, and awe-inspiring.

In modern times, people discovered that birds could not tolerate limitless changes to their environment. Mankind's populations shifted to the cities. Here, they found that they missed the feathered beauties they had known on their farms and in village greens. And they became aware that human predation in many forms could cause unexpected reduction or extinction of species of birds they had once thought to be superabundant.

From these new discoveries of the impacts of unguided and thoughtless change, conservation was born. More people are more interested in birdlife with each passing year. In some ways, people perceive the success and variety of bird populations as an indicator of the health and well-being of their own environment and conditions of life. With the rapid pace of modern existence, people are discovering the restful joy of knowing about the natural world around them. And to many, the loveliest and most observable and interesting of the animals in this world are the birds.

The fact that you are reading this book proves you are fascinated by birds and wish to know more about them. Pursuing an interest in birdlife is rewarding even for those who do not intend to engage in extensive scientific study. Think of your amateur appreciation of birds as parallel to enjoying a work of fiction without becoming a novelist.

This book is an attempt to summarize many aspects of the natural history, conservation, and enjoyment of birds in Pennsylvania. The information presented here is collected from hundreds of sources, including many books, periodicals, and circulars. It is related in a form colored by our own personal experiences and love of wild creatures. We hope our readers find this book stimulating and will pursue their interest in the amazing lives of birds.

THE ANNUAL CYCLE

The activities of wild birds are synchronized with the seasons. Each important stage in the annual cycle occurs when environmental conditions are most favorable, minimizing stress on the birds and improving their chances for survival. Imagine what would happen if robins tried to nest and raise their young during a Pennsylvania winter. But they never do. Over the millions of years of their development, nature has programmed robins and all other birds to court their mates and produce their young during the long, warm days of spring and summer, when food is abundant.

To synchronize their breeding and other activities with the appropriate seasons, birds use a natural calendar that is as accurate as any devised by man. It is the sun's calendar, produced by the tilt of the earth on its axis as the planet makes its annual journey around the sun. It is responsible for the changes we see in the length of a day, varying continuously from the year's shortest day on December 21 to its longest on June 21. Even humans recognize and respond to these celestial events. Man has used the sun's calendar for thousands of years to determine the best times to plant and harvest crops. But nature's feathered creatures use the calendar to perfection, initiating courtship, molting their worn plumage, and departing on long migratory journeys when day length reaches a pre-programmed value, signaling that the time is right.

Not all birds breed at exactly the same time, because different species respond to different critical day lengths. Thus robins are among the earliest birds to begin their courting in Pennsylvania, several months before the late-breeding goldfinches finally choose their mates. Robins are genetically programmed to breed while days in spring are still very short. But if we put a pair of robins in an indoor aviary and closely regulate the day length by providing artificial light, we

Over the millions of years of their development, the activities of birds have become synchronized with the most favorable environmental conditions. Migration, courtship, nesting, and molting all occur at the most opportune time to ultimately ensure the species' survival.

Leonard Lee Rue

can easily induce the birds to breed at a different time than they would in the wild.

Even for a single species, the timing of breeding and other activities often varies from year to year in response to periods of untimely weather. A late, cold spring can inhibit courtship beyond the time when day length is appropriate. Some birds may even start to sing and establish breeding territories in early spring, only to be silenced temporarily by an unseasonable snowstorm. Once the snow disappears and the days are warm again, the birds enthusiastically resume their singing.

In the lives of most birds, the annual cycle begins in spring with the establishment of breeding territories, the selection of mates, and the promise of new life. At this time, our year-round residents are joined by scores of migrants returning from their southerly wintering areas. It is a time of intense competition, as individuals jostle for mates and for places to breed.

The Breeding Territory

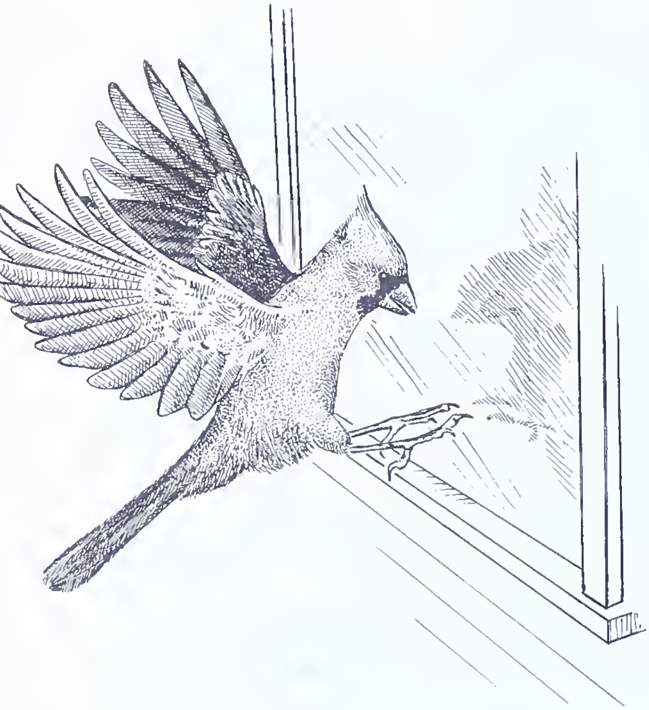
The breeding territory is an area that is defended, usually by one bird, against intrusion by other birds of the same species, or of closely related species. Almost all birds are territorial during at least a portion of the breeding season. Species vary greatly in the size of the area they defend and in the activities that take place within the territory.

Most songbirds establish territories that include the nest site and a spacious feeding area. Others, such as the American goldfinches and red-winged blackbirds, defend an area surrounding their nests but forage with others of their kind in undefended communal feeding areas. The extreme example of this behavior is shown by many colonial seabirds whose tiny territories may be no larger than the distance they can reach with their bills while sitting on their nests. Nesting space is at a premium, but food is plentiful in nearby waters where the birds forage gregariously. Another variation is shown by some waterfowl whose territories may not even include the nest site. Still others, such as male American woodcock, defend small courting territories where they mate with any females they are able to attract. Their territories provide neither food nor nesting sites, but fulfill the needs of their kind.

Among songbirds, it is generally the male who establishes the breeding territory and tries to entice one or more females to share it with him. Males defend their territories against others of their species by combinations of threatening displays, singing, short pursuit flights, and actual combat. Birds are generally more combative early in the breeding season when territorial boundaries are first being disputed. During this time, new arrivals may try to squeeze in among the established landowners. After territorial boundaries become fixed, songs and threatening postures are sufficient to prevent intrusion by neighboring birds.

By establishing a territory, a male bird monopolizes an area's resources — its food, nesting sites, and cover — for the family's exclusive use. The territorial system actually reduces the amount of conflict between individual birds by allowing each to live relatively unmolested within recognized boundaries. Having staked his claim, a bird can devote more of his energy to producing his young and less to defending his holding.

Birds that establish their territories in suburban yards, particularly robins and cardinals, are often attracted to their own images in windows, automobile hubcaps, and other reflective surfaces. Vigorous territorial combat can result. These bouts may occur off and on for days or weeks, and are sometimes severe enough to result in injury to the single combatant. Although the bird will eventually



In defense of their territories, many birds are often attracted to their own reflections in windows and other reflective surfaces. Concerned homeowners can spare birds from these needless endeavors by reducing the reflectiveness of such surfaces.

become accustomed to seeing its own image and will stop challenging it, the concerned homeowner might reduce the reflectiveness of the offending window by smearing it with glass wax or temporarily applying a covering of paper to the outside of the pane.

Many factors affect the size of breeding territories for songbirds. In a very general way, the larger the bird the larger its territory. But this trend is modified greatly by availability of food, age of the bird, and density of the population. In areas with more abundant food supplies, territories tend to be smaller. Young birds breeding for the first time usually establish smaller territories than more experienced breeders. And the more birds trying to establish territories in a given year, the smaller each territory will be. Even under intense competition, territory size can be reduced only so much. Eventually, any additional birds seeking to establish territories will be forced to go elsewhere to find space or will remain in the area as a non-breeding surplus population. In this way, many songbirds prevent overpopulation and overuse of an area's food resources, by putting an upper limit on the density of breeding pairs.

Why Do Birds Sing?

In poetry, birds sing for the sheer joy of living. Although that explanation cannot be ruled out, there are many more practical purposes for bird sounds.

Bird Calls and Songs

Ornithologists recognize two kinds of bird vocalizations — songs and calls. Calls are generally brief sounds of only one or two notes that are made by individuals of either sex at any time of the year. Calling birds may be communicating their location to the other members of a feeding or migrating flock, rallying their young around them, or warning of an approaching predator. Certain calls, particularly the alarm calls, are very similar from species to species. Because of this similarity, an alarm call uttered by one bird at the sight of a marauding house cat will be recognized by other species within earshot, warning them of the danger, too. In fact, the alarm calls of birds are even heeded by some mammals. Unlucky is the deer hunter who is spotted by a flock of scolding jays.

A bird's true song, in contrast, is usually a rhythmic series of notes, uttered in a stereotyped and recognizable pattern. Songs are given predominantly by the male of most species as part of his courtship activities, and can be very melodious and beautiful. Everyone is likely to have his own favorites. Most listeners agree that the thrushes, sparrows, mockingbird and thrasher, meadowlark, and wrens are among Pennsylvania's finest songsters.

The Functions and Timing of Song

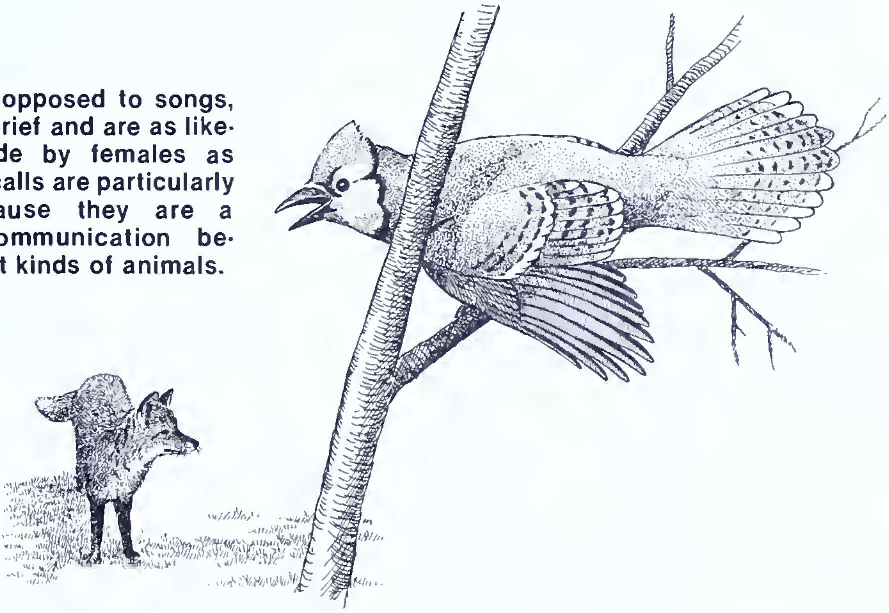
Like its calls, a bird's song is a form of communication between individuals, primarily of the same species. Although females of certain species also sing, bird song is stimulated primarily by the male sex hormones and is generally a phenomenon of the reproductive season. A male's song serves to identify his sex and attract potential mates. It also advertises his presence to any would-be intruders into his territory. Singing may also help to stimulate and synchronize a pair's sexual behavior, and strengthen the pair bond. A distinctive song is one of nature's ways of ensuring that birds will mate only with members of their own species.

Birds sing primarily in the morning and evening, with reduced vocalization during the heat of midday. But most birds will respond, or counter-sing, to another bird's singing at any time of the day. Birds generally sing only during the daylight hours, but several species are noted for their nighttime performances. Thrushes and whip-poorwills often sing at dusk. The songs of cuckoos, marsh wrens, mockingbirds, ovenbirds, chats, and field and grasshopper sparrows issue forth in daylight or darkness. And, of course, the nocturnal owls advertise their amorous intentions with haunting nighttime voices.

The amount of time birds devote to singing indicates the importance of song to their lives. At the height of the breeding season, this time commitment can be considerable. One song sparrow in Ohio was observed to sing for 9 hours out of 24. A song sparrow typically repeats his song 1,500 times a day. But the record for a Pennsylvania resident goes to the vociferous red-eyed vireo—one was heard to sing an incredible 22,197 songs in a day.

Other Bird Sounds

Many birds make non-vocal sounds that serve the same function as songs or calls. Often these are made mechanically by forcing air through the feathers of the wings or tail, while the bird is either flying or fanning its wings rapidly on the ground. The booming sound of the nighthawk's dive and the twittering display flight of the woodcock are caused by wind moving through their specially adapted primary wing feathers. A drumming ruffed grouse also uses his wings,



Bird calls, as opposed to songs, are relatively brief and are as likely to be made by females as males. Alarm calls are particularly unusual because they are a means of communication between different kinds of animals.

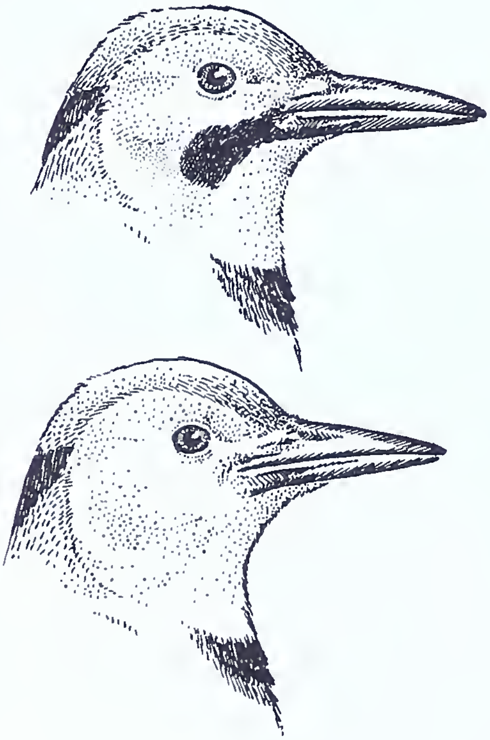
beating them vigorously while perched on a log. In contrast, the quavering flight sound of the common snipe is produced by the feathers of the tail.

Rather than using their feathers, some birds send messages with their beaks. A well-known example is the staccato tapping of woodpeckers on hollow branches or on the rain gutters of your house. Each species of woodpecker makes a distinctive sound which identifies it and advertises its presence, much like the songs of other birds.

Courting and Selecting a Mate

Recognizing a Potential Mate

The lusty singing of the territorial male songbird is only part of the courtship ritual that eventually results in copulation and production of young. With his song, the male identifies himself, advertises for a mate, and warns intruding males to stay away from his territory. Any bird caught trespassing, whether male or female, may be attacked. How, then, does the territory owner distinguish between an aggressor and a possible mate?



In some birds, sex recognition may be based entirely on feather coloring. This is possible only in species which are sexually dimorphic—that is, males and females have a different appearance. Even to the human eye, the brightly colored male red-winged blackbird, American goldfinch, cardinal, scarlet tanager, and eastern bluebird can easily be distinguished from their inconspicuous mates.

Sometimes the differences in plumage between the sexes can be quite subtle. A male northern flicker, for instance, is almost identical to his mate, except that he has a dark "mustache" extending down from his bill, while the female has none. This mustache is critical for sex recognition in flickers. An ornithologist once captured a mated female flicker, painted a mustache on her face, and released her to rejoin her mate. The male responded by attacking her, as though she were just another male intruding into his territory.

For those species in which the sexes are similarly colored, differences in behavior help distinguish males from females. A male song sparrow trespassing in the territory of another male will either flee or respond aggressively when challenged. But an interested female in breeding condition responds with submissive postures and special call notes, pacifying the male and inducing him to court her.

The Diversity of Courtship Displays

Birds have developed an astonishing variety of courtship behavior. No two

The black "mustache" on the male common flicker is an avian example of sexual dimorphism — a visible characteristic that distinguishes males from females. Results from past studies demonstrated how this subtle mark is necessary for sex recognition for this species.

species are quite the same. They sing or make other enticing sounds, dance or strut, perform complex aerobatics, display graceful plumes, or flash brightly colored patches of feathers or skin. Even species that are among nature's shyest creatures when not courting become suddenly conspicuous as they woo their mates. A good example is the elusive American woodcock, whose silence and leaflike plumage make it difficult to find in the wild without the aid of well-trained pointing dogs. But during the spring courtship period, the woodcock combines insectlike noises, ritualized strutting, a spiraling display flight, twittering wings, and a warbling song into a nuptial performance guaranteed to warm the heart of the most disinterested female.

One ritual performed by many species of birds is courtship feeding. The male presents choice tidbits to his mate, who often assumes the gaping pose of a young bird accepting food from its parent. In most species, courtship feeding is entirely symbolic rather than nutritional. Thus even a well-fed bird will beg for food from her mate, and birds can be seen feeding each other even while standing on a full feeding tray.

Through courtship feeding, birds establish and maintain the pair bond that unites them during the time they produce their young. For many species, courtship feeding is a prelude to copulation, and may be essential to stimulate the sexual act. Male yellow-billed cuckoos and bitterns even feed their mates during copulation.

Courtship feeding is common only in those species that normally feed their own young. The behavior seems to be absent in ducks and grouse, whose young gather their own food. Thus the symbolic feeding of one's mate is a ritualized extension of the normal behavior of a parent caring for its young.

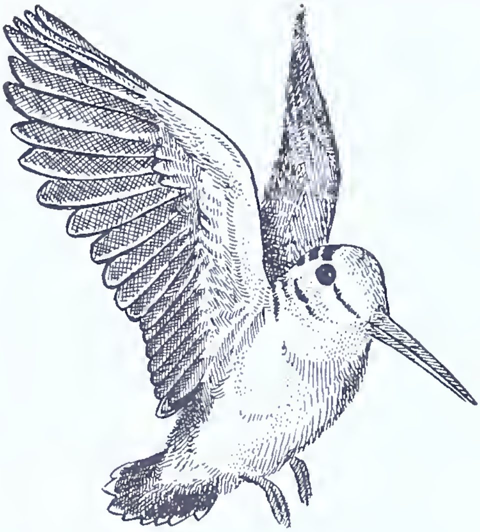
The Pair Bond

Breeding birds form attachments to their mates that can be likened to marriage in most human cultures. Whether the bond between a mated pair results from mutual affection or from some other cause is not well known. It is possible that birds form an attachment primarily to the territory or to the nest site itself, rather than to each other. However, many birds are able to recognize their own mates, picking them out of a crowd of similar birds. Recognition is a necessary first step in formation of a true emotional relationship. There are also many published examples of dedication to injured, dead, or dying mates that suggest the pair bond is cemented with affection in many species.

The duration of the pair bond varies from a few minutes to a lifetime in different bird species. The sexual encounter for some birds is so brief that no pair bond may be formed at all. Grouse and woodcock may be in the latter category. Males and females meet for a few minutes on the male's displaying area, copulation takes place, and the female departs to make

The attractive nuptial plumes of the snowy egret were once in such demand that market hunters almost exterminated this species.

Leonard Lee Rue



The inconspicuous woodcock comes out of hiding when courtship season begins, and goes into an elaborate routine highlighted by a spectacular spiraling display flight.

her nest and raise her brood. The males take no responsibility for raising their own young. Ruby-throated hummingbirds associate with their mates for only a few days at the time of copulation.

Most ducks have a long engagement but a short marriage. They court during late fall and winter while still in their wintering areas. In spring they migrate north as mated pairs. Thus drakes and hens associate with one another for several months before nesting. Yet, once the eggs are laid or once they hatch, the adults go their separate ways.

Most songbirds remain faithful to their mates throughout courtship, nesting, and brood rearing, although a new mate may be selected for a second nesting attempt. By the following year most birds will have changed partners. Despite the high divorce rate, records show that a pair of mockingbirds and a pair of cardinals each mated for three years, and a pair of song sparrows banded in Rhode Island remained together for four years.

Very few species of wild birds mate for life. Lifetime partnerships are more commonly seen in captive or domesticated birds which may have very little choice in selecting a mate. Some seabirds, such as albatrosses and petrels, may form permanent pair bonds. Many geese, swans, and cranes also choose lifelong partners. Among the smaller birds, tufted titmice, white-breasted nuthatches, and brown creepers sometimes form lasting bonds. Even birds that form permanent pairs will usually find a new mate in the event of one's death.

How Many Mates?

The formation of pair bonds results in monogamous matings in most birds. This means that each male has only one female at a time, although he may change mates at more-or-less frequent intervals depending on the strength and duration of the pair bond. Monogamy tends to be the rule in species that need both parents to feed the young. But in species that use reliable and abundant food sources, or whose young are able to feed themselves, a male can often afford more than one mate.

There are two kinds of sexual relationships involving multiple mates—promiscuity and polygamy. Promiscuous species come together only to copulate. Then the female goes off alone to nest while the male seeks additional mates. This form of mating is practiced by grouse, woodcock, and hummingbirds in Pennsylvania.

Polygamy involves the formation of simultaneous bonds between one male and several females (polygyny) or one female and several males (polyandry). Polyandry is relatively rare and is seen primarily among species in which the sex roles are reversed. Thus the male has responsibility for building the nest, incubating the eggs, and caring for the young, while the female gathers additional males into the territory that she defends. Polyandry is known in the rheas and tinamous of South America and in Central American jacanas. There are no examples in this state.

Polygyny — one male to several females—is common in ring-necked pheasants, red-winged blackbirds, bobolinks, dickcissels, and house wrens. In addition, some species that are usually monogamous practice polygamy on occasion. These include some hawks, swans, mourning doves, flycatchers, sparrows, titmice, thrushes, warblers, and purple martins.

Nests and Nesting

Not all species wait until courtship is over and the marriage knot is firmly tied before they begin to build the nest that will receive their eggs. The choice of a nesting place may be an important part of the courtship ritual for some birds. For others, such as house wrens and prothonotary warblers, the male may choose a site within his territory and begin construction before the arrival of the late-migrating female. The male wren starts building several nests, then lets his mate choose the one she wants to furnish. For most species, however, it is the female who selects the nest site and does the lion's share of nest construction.

A nest is more than just a dish to hold the eggs. During adverse weather, the nest is a snug shelter for the eggs and young, the most vulnerable stages in the life of a bird. And the nest protects its occupants from the searching eyes of predators. Many birds guard against enemies by building their nests in the most inaccessible locations—on a ledge on a sheer cliff, in the highest branches of a tall tree, at the end of a deep burrow in a river bank, or on a floating island of dead vegetation in the midst of a marsh. Other birds are so adept at camouflage that their nests go unnoticed even on the ground or in low vegetation. So cryptic are the nests of the woodcock and the whippoorwill that predators may pass close by without detecting them. By building out of materials that match their surroundings, most birds reduce the conspicuousness of their nests. Birds that nest in colonies, such as herons and beach-nesting terns, rely on force of numbers to repel predators. And certain other species, such as swans and geese, are sufficiently large and aggressive that they can discourage most enemies without assistance.

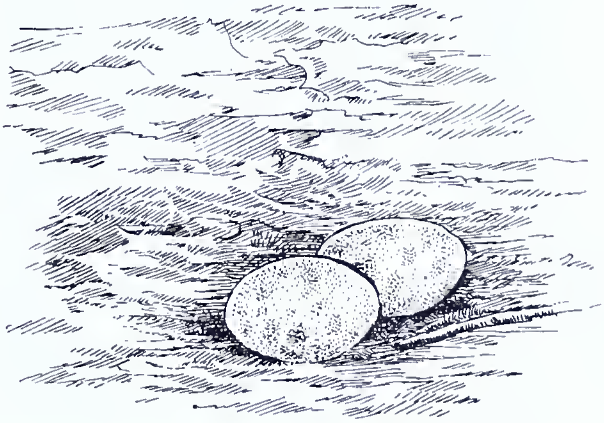
Another function of the nest is to provide essential warmth to the developing eggs and young. The nest cup retains the warmth of the incubating parent, and insulates against the cold nighttime air. For many species, the nest is a snug nursery for the downy nestlings during the time that they are completely dependent upon their parents.

The Infinite Variety of Nests

Birds have devised an astonishing array of nests that fit in to the diverse habitats they live in. Many seabirds make no nest at all, preferring to lay their eggs directly on the bare rocks or shifting sand on their coastal or island breeding colonies. Others assemble rough nests of dried seaweed or beach grasses. Some inland birds, such as turkey vultures and whippoorwills, also lay directly on the earth or on scattered leaves.

Kingfishers and bank swallows nest in the earth, rather than on it. They use

Birds have devised an infinite variety of nesting strategies. An example of one extreme is by the whip-poor-will, which makes no nest at all but merely lays its eggs on bare ground.



their bills and feet with great skill to burrow deep into vertical banks, often along streams.

Woodpeckers and other cavity-nesting birds excavate their holes in the trunks or limbs of standing trees, or they re-use holes abandoned by some previous excavator. In the desert of the American Southwest, with its shortage of trees, the gila woodpecker digs its cavity in the side of the giant saguaro cactus.

Many birds assemble any materials that are available into rough nests on the ground or over water. Grebes and some diving ducks build floating islands of water plants that they anchor to emergent vegetation such as cattails or rushes. American woodcock scrape out a cuplike depression in the ground and line it with dead leaves and small twigs, while ruffed grouse adorn their shallow scrapes with leaves, conifer needles, and molted feathers. Many waterfowl line their nests with soft down that the female plucks from her own breast. This downy comforter is an excellent insulator for the eggs, and the female often pulls the down carefully over the clutch before taking a short break to drink or feed. Champions among down producers are the common eider ducks, which nest colonially along the northern coasts from Maine to Alaska. Their down is highly prized by humans for expensive comforters and cold-weather clothing. People who make a living gathering eider down harvest it not from the birds, but rather from their nests. In most places, regulations permit them to collect down only once during incubation, which the eider hen quickly replaces. A second harvest is made after the hen has departed with her newly hatched brood of ducklings.

The chickadees are some of the birds which nest in cavities, one of the more secure types of nests. Chickadees nest in partly decayed wood and both members of the pair share the excavating responsibilities.

Steve Maslowski

Many species of birds use the support of trees or shrubs to suspend their nests above the level of the ground, out of reach of most ground-dwelling predators. The simplest such nests are the platforms of twigs and sticks built by some accipiters, such as Cooper's and sharp-shinned hawks. Herons, bitterns, pigeons, cuckoos, and doves also build rough platforms that barely contain the eggs. Nests of the mourning dove are so sparse that the eggs are often visible from below, through the spaces between sticks.

Most songbirds create more elaborate, cup-shaped nests that cradle the eggs and growing nestlings. These commonly consist of a cup of woven grasses lined with finer grasses or other fibers, resting on a foundation of twigs. The robin's grass nest is cemented together with mud, and field sparrows line their grass-and-leaf nests with horsehair, when they can get it. And the blue-gray gnatcatcher creates a delicate cuplike nest of moss and fine grasses, held in place with spider web and lined with hair or thistledown.

The eastern phoebe's nest is also cup shaped, but is built predominantly of mud and moss, with a soft lining of feathers, hair, or grass. Instead of using a tree or shrub for support, the phoebe plasters its nest to the wall of a cave or steep ravine. It frequently builds on manmade structures, such as the rafters of barns, and commonly nests beneath bridges and trestles that span water. Barn and cliff swallows also make mud nests that they stick to walls and rock faces. A unique form of adherent nest is created by the chimney swift, which uses quantities of sticky salivary mucus to glue its twig nest to the inside wall of a chimney or hollow tree. The ultimate saliva nests are those of the far eastern edible swiftlets whose nests are composed entirely of mucus, and are the basic ingredient for the Chinese delicacy birds'-nest soup.

Several bird species install roofs over their nests. These help to shed moisture and hide the eggs and young. The ovenbird's nest is built on the ground, with a domed roof and side entrance that give it an oven-like appearance.

Among the most intricate birds' nests are those of the orioles. They weave a delicate pouch of hair, plant fibers, and string, and suspend it by its rim in the branches of an elm or maple.

Among Pennsylvania's birds, it is the ruby-throated hummingbird that builds the smallest true nest — about one inch high and one inch wide. The bald eagle easily takes the prize for the largest nest. One nest in Ohio was used for 35 years and weighed two tons. Another eagle's nest in Florida was 9.5 feet across and 20 feet deep — and was located in a tree!

Age at First Nesting

Most of our small birds breed for the first time when they are nine months to one year old, during the first spring or summer after hatching. Some tropical birds breed even earlier. The budgerigar, a common cage bird in this country, first produces eggs at three months of age. And some Australian finches begin laying when only 11 weeks old.

In general, smaller species mature more rapidly than larger species. Although most songbirds, ducks,

The cliff swallow nest, above, is constructed with mud and lined with grass and feathers. The goldfinch's cup-shaped nest, center, is an example of the type of nest built by most songbirds. Ospreys build substantial nests, as shown at right, often in conspicuous places.

Northern orioles build possibly the most elaborate nests among songbirds in Pennsylvania. The delicate pouch suspended from the tips of twigs is safe from most nest predators.

doves, grouse, and quail breed when one year old, geese, gulls, crows, swifts, and small hawks generally nest first at two years. Ospreys wait until three years old, and swans and eagles breed at four or five years.

In some species, psychological stress brought about by interactions with older, more dominant birds may inhibit young birds from breeding as soon as they otherwise might. Thus male pheasants and wild turkeys often breed first at two years of age while females mate in their first year. Presumably, this is because young males are dominated by the older birds. Similarly, year-old red-winged blackbirds may be unable to establish breeding territories in marshes among the older males. Under this intense competition, their reproductive organs fail to develop fully, and they may not breed.

Timing of Egg Laying

In the domestic hen, it takes about 24 hours between the time a ripened ovum (the egg yolk) bursts from the bird's ovary until it is laid into the nest. In this interval, it accumulates the egg white and a sturdy shell. Normally, a second ovum does not start on its journey along the reproductive tract until the previous egg has been laid. Thus a hen generally lays once per day until its clutch of eggs is complete.

Like the hen, most wild birds, such as songbirds, many ducks, woodpeckers, and small shore birds, also produce one egg every 24 hours. No birds are known to lay consistently more quickly, although many species take more time between successive eggs. The larger grebes, swans, herons, doves, owls, hummingbirds, and kingfishers lay eggs 38 to 48 hours apart. Penguins lay once every three days and condors every five days. Often the later eggs in a clutch come less frequently than the first few eggs. Thus the initial 24 hours between eggs may stretch to 48 hours by the fourth or fifth egg.

The time required "in labor" to lay an egg varies from a few seconds for the brown-headed cowbird to more than an hour for geese and turkeys. Many songbirds can delay laying if the weather is cold or if the nest is not yet ready. Cowbirds and other brood parasites, which lay their eggs in the nest of a foster parent, can postpone laying until the host leaves its nest, then expel the egg almost instantly before the other bird returns.

Most birds lay their eggs in the early morning, either shortly before or after sunrise. Morning layers include robins, purple martins, cedar waxwings, red-eyed vireos, ovenbirds, goldfinches, and song sparrows. However, some flycatchers may lay later in the morning, pheasants commonly lay in the evening, and American coots shortly after midnight.

Egg Sizes, Shapes and Colors

It is not surprising that larger birds lay larger eggs. The eggs of the tiniest hummingbird are less than one-half inch long, while the largest eggs produced by a living bird, the ostrich, measure nearly 7 inches long and 5.5 inches wide. But even the ostrich's eggs are dwarfed by those of the extinct elephant birds of Madagascar. Now fossilized, their eggs measured 13.5 inches long and 9.5 inches in diameter, and had a volume of about two gallons.

Although small birds produce small eggs, their eggs are actually larger relative to their body size than those of the biggest birds. The melon-size egg of the ostrich weighs less than 2% of the bird's body weight, while the diminutive wren lays an egg equal to 13% of its weight.

Even within a single bird species, the sizes of eggs may vary. Young birds, for example, often produce smaller eggs than older birds of the same species. And any bird may produce runt eggs now and then. These abnormally small eggs usually do not hatch.

Most birds lay eggs that are oval in shape, like those of a domestic chicken, but eggs of other species vary from the streamlined shape produced by swifts and swallows to the round eggs of owls and kingfishers. The eggs of many cliff-nesting seabirds are more pointed at one end. This permits them to roll in a tight circle if they are bumped. Presumably this is an adaptation for nesting on rock ledges, where a round egg would be smashed if it rolled over the edge.

The eggs of some birds are white or nearly so. Yet among the bird world as a whole, eggs come in a remarkable variety of patterns and colors. The source of the color added to the egg's shell is the same in all birds. It is the blood pigment hemoglobin and products derived from the breakdown of old, worn-out blood cells. The pigment is secreted by the wall of the oviduct at the time the egg's shell is being formed, and may be laid down in a smooth, even coat or in splotches and dapples of color.

Many species produce solid-colored eggs. Those of the robin are bright blue, the catbird's are green, and the bittern's are olive brown. Others splatter their eggs with irregular patterns of brown, red, or black spots. This speckling may cover the entire surface of the egg or, as for many sparrows, may be concentrated in a crown around the larger end of the egg.

Patterned eggs probably developed to make them less conspicuous to egg-eating predators. Skunks, foxes, raccoons, and snakes are notorious nest marauders. The woodcock's dappled eggs are nearly invisible in their leafy nest, as are those of the whip-poorwill which lay its eggs directly on the ground. The pale greenish eggs of most ducks are quite conspicuous, so the hen is careful to pull the nesting material over them whenever she must leave to feed. Woodpeckers and kingfishers, whose nests in tree cavities or in stream banks are virtually inaccessible, can afford to lay sparkling white eggs.

How Many Eggs?

The number of eggs a bird lays in a single nesting attempt is called a clutch. Clutch size varies greatly among Pennsylvania's breeding birds. Mourning doves, pigeons, nighthawks, hummingbirds, and turkey vultures rarely produce more than one or two eggs per nest. Herring gulls, great horned owls, and ospreys generally lay two or three eggs, while snipe, woodcock, and sandpipers almost always lay four. Many of the songbirds, such as sparrows, mockingbirds, and warblers, produce clutches of four or five eggs, but the tiny black-capped chickadee has been known to fill its nesting cavity with as many as 10 eggs. Some of the largest clutches to be found in Pennsylvania are those of mallards (5-14 eggs), ruffed grouse (8-14 eggs), wild turkey (8-20 eggs), and ring-necked pheasants (5-23 eggs).

Occasionally, nests are found containing even larger numbers of eggs, but these are usually the work of more than one female. Bobwhite quail nests have contained up to 30 eggs, and a pile of 40 eggs was discovered in a wood duck's nest. Abnormally large nests containing eggs laid by more than one bird are known as "dump nests." These usually are not incubated and do not hatch. The reasons for dump nesting are not clear, but they may be produced by hens that lose their own nests during the laying period. One dump nest of the redhead, a prairie-breeding duck, held 87 eggs that undoubtedly were contributed by many different hens.

It is not at all unusual for one bird to add a small number of eggs to the nest of another bird, even of another species, and have those eggs accepted and reared by the foster parent. Brown-headed cowbirds do this routinely. They are obligate parasites that never build a nest or care for their own young. But there are other species that normally incubate their own eggs and raise their own young, yet frequently will lay eggs in another bird's nest. These occasional, or nonobligate, parasites include the pied-billed and eared grebes, yellow-billed and black-billed cuckoos, Virginia rail, brown thrasher, starling, house sparrow, house finch, and some native sparrows. Occasionally a bobwhite quail will lay in a pheasant's nest, and pheasants sometimes lay in waterfowl nests or in the nest of another pheasant.

The normal clutch size is fairly constant for each bird species, and thus is probably genetically controlled. There are some birds, however, that are capable of laying astonishing numbers of eggs, even though they seldom do. These so-called "indeterminate layers" generally produce eggs, one by one, until they have accumulated a clutch of normal size. But if eggs are removed as they are laid, the birds will continue to lay egg after egg in a futile attempt to produce a normal clutch. Ducks, grouse and other gallinaceous birds, some woodpeckers, house wrens, and house sparrows are all indeterminate layers, and there are some astonishing records of egg laying by these species. In the 1800's, an ornithologist stole the eggs of a northern flicker just as fast as she produced them, always leaving at least one egg in the nest so the bird would not abandon it entirely. Although the typical clutch size is 5 to 10, this flicker produced 71 eggs over a period of 73 days before she finally gave up. Of course, the trait of indeterminate laying is artifically selected by man in the domestic birds he raises. Certain breeds of domestic chickens routinely produce 300 eggs per year. In what may be the record for egg laying by any bird, the artificially propagated Japanese (coturnix) quail has been known to produce 365 eggs in one year.

At the other end of the spectrum are

Most birds are determinate layers; i.e., they lay a relatively constant number of eggs. Some, however, such as woodpeckers, are indeterminate layers and will keep laying eggs until a normal size clutch is accumulated.

species such as shore birds, hawks, and most songbirds, whose egg production is fixed by nature. They cannot be induced to lay more than their normal clutch even by removing their eggs. Instead, these birds will be satisfied to incubate and raise whatever eggs are left them. This trait makes them less able to compensate for losses of eggs that may occur during the laying period, perhaps due to accidents or to egg-eating predators.

It is generally thought that birds have been programmed through evolution to produce as many young as they are capable of rearing in an average year. Thus the clutch size of each species of bird is appropriate to its own way of life, and is the size that usually results in the largest number of young being raised and surviving to breed themselves. This idea is supported by the fact that species in which the parents gather all the food for their helpless young, such as in hawks and songbirds, generally have much smaller clutches than species, like grouse and ducks, whose young are able to find their own food. The parents of nest-bound, altricial young can gather only so much food in a day, and thus can raise only a small brood. On the other hand, a grouse need only lead its active, precocial brood to a good foraging area and the chicks will feed themselves.

Even among species producing precocial young, environmental pressures keep these broods small. One problem is that larger broods tend to attract predators, while smaller broods are more easily hidden, and are more likely to survive unnoticed.

Through decades of observation, ornithologists have identified many factors that influence the number of eggs a bird will lay in a given year. The age of the bird is important, because young birds generally lay smaller clutches than older birds. The type of nest has an effect, hole-nesting species generally having larger clutches than open nesters. Even in a single species of cavity-nesting bird, such as the titmouse, individuals nesting in larger nestboxes produce more eggs than those housed in more cramped quarters. Some hawks and owls lay larger clutches in years when prey species are particularly abundant, and may not nest at all when food is scarce. Many birds produce smaller clutches in years when population levels are high. This mechanism is thought to keep bird populations in balance with their environments.

How Many Clutches?

Many birds raise more than one brood per year in Pennsylvania. Among the common garden songbirds, cardinals, gray catbirds, black-capped chickadees, starlings, barn and tree swallows, brown thrashers, and ruby-throated hummingbirds generally produce two clutches per year. Bluebirds, American robins, song sparrows, house wrens, and eastern phoebes may raise two or three broods in a season. Generally it is the smaller birds, whose courtship and nesting periods are fairly brief, that have time to raise more than one family in a year. To hasten the process, some birds start building a new nest and lay a new clutch of eggs even before the young of their previous brood are fully fledged.

Even species that are normally single brooded will usually produce a replacement clutch if the first is destroyed. In pigeons, song sparrows, and starlings, the birds will start laying a replacement clutch as soon as five to eight days after loss of the initial clutch. In waterfowl, the probability of renesting depends on the timing of nest destruction. Eggs lost early in incubation are usually replaced, but most ducks fail to renest if their first clutches are lost shortly before or after hatching. At best, replacement clutches are often smaller than initial clutches. An average of 11 eggs comprise a bobwhite's replacement clutch, while first clutches average 14. And for ruffed grouse, the average clutch size declines from 11 in initial nests to 8 in renests.

Most birds are capable of producing

eggs throughout their lives. The life spans of wild birds are short enough that they generally do not outlive their reproductive years (see Mortality and Longevity). However, there are records of birds producing clutches regularly at very advanced ages. One captive herring gull laid eggs each year for 42 years. And a captive pair of eagle owls in England was still producing young when the male was 53 years old and the female was 68.

Incubation

Particularly for indeterminate layers, it may be the "feel" of a full clutch of eggs against its belly that induces the bird to stop laying and start incubating. In many ways, incubation in a bird is similar to pregnancy in a mammal. It is a time of rapid development of the embryonic bird in preparation for its dramatic debut into the world. But in a bird, the embryo is isolated from the body of its parent, dependent upon the adult only for protection and warmth.

The transfer of heat from the parent's body to the eggs can be greatly enhanced by the formation of an "incubation patch" or brood patch. The incubation patch of many birds consists of one or more areas of skin on the belly that lose their insulating feathers and develop a rich supply of blood vessels. The patch often appears swollen and inflamed, and is quite warm to the touch. When an incubating bird settles over its eggs, the skin of the brood patch is in direct contact with the eggs, with no intervening layers of feathers that might impede the flow of heat to the eggs.

Not all birds develop an incubation patch, and some have more than one. Most songbirds and birds of prey develop one patch that is centrally located on the belly. Shore birds get two patches located side by side, and grouse and other gallinaceous birds form three separate patches, one in the middle and one on each side. Other species, such as ducks and geese, have no true incubation patch at all, although they may enhance the transfer of heat to their eggs by plucking feathers from their breasts.

Generally, the parent that incubates the eggs is the one that develops a brood patch. This is usually, but not always, the female. In most songbirds, only the female possesses a brood patch. Males of many songbirds will occasionally sit on the eggs but their incubating is not as efficient as the females'. In the phalaropes, a species that breeds in the arctic but occasionally migrates through Pennsylvania, the male develops the brood patch and does all the incubating. In still other species, like the cuckoos, both male and female share in incubation, and both have brood patches.

An incubating bird maintains the temperature of its eggs at roughly 93 degrees Fahrenheit, while its own body temperature may be between 103 and 109 degrees. At this temperature, development of the embryo is rapid. The eggs of wild birds can also withstand a considerable amount of chilling, although their development may be slowed. Many birds leave their nests unattended for an hour or more each day, and during this time the eggs cool to air temperature. Some eggs can survive several days of chilling, and mallard eggs have hatched normally even after cracking at freezing temperatures.

The time it takes bird eggs to hatch varies widely. Small songbirds, such as finches and sparrows, generally incubate for 12 to 15 days. Ruby-throated hummingbirds take about 16 days, woodcock 20 days, and bobwhite 23 days. The larger the bird, the longer its incubation time. Great blue herons incubate about 28 days, tundra swans 32 days, and bald eagles 35 days.

All birds occasionally rotate their eggs as they incubate. Turning the eggs one or more times per hour helps them to heat evenly and keeps the embryonic membranes from sticking to the inside of the shell. With each turning, the yolk of the egg rotates, so that the developing embryo is always uppermost in the shell.

Most birds begin to incubate when the last egg in the clutch has been laid. Without incubation, development of the first-laid egg is retarded so that the whole clutch hatches at the same time. Such synchronous hatching is clearly beneficial to species like mallards and pheasants, which immediately lead their precocial broods from the nest in search of food and protective cover. Any unhatched eggs are left behind for the scavengers. Songbirds, too, benefit from the simultaneous hatching of their young. All at once the adults are freed from the time-consuming chore of incubation, to start gathering food for their hungry nestlings.

Loons, grebes, herons, hawks, owls, and eagles are among the species that start incubating with the laying of their first egg. Consequently, their young hatch at different times, over a period of several days, so that a single brood consists of nestlings of different sizes and ages. Young barn owls, for example, may differ in age by as much as 15 days. The youngest bird in the brood is constantly overshadowed by its larger siblings and loses out in competition for food brought to the nest by its parents. It survives only in the best of years, when food is plentiful and its nest-mates are sated. During lean years, the youngest nestling starves and may even be cannibalized by its brothers and sisters. But by perishing, it ensures its siblings' survival. Bringing the brood size into balance with the supply of food prevents the loss of the entire brood.

Development and Care of the Young

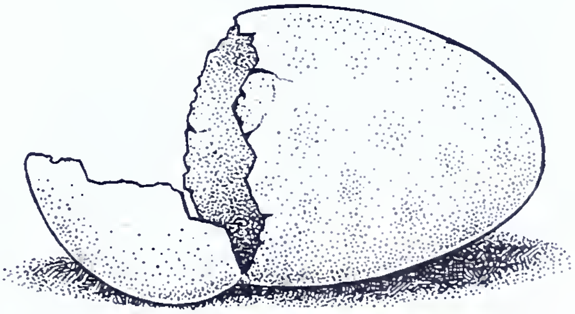
Breaking Free of the Egg

By the time the fetal bird is ready to burst from its tiny prison, it has already developed the tools it needs to make its escape. Escape from the egg is strictly an "inside job," as the parents generally do no more than watch from the sidelines, perhaps gently picking at the shell fragments that the youngster breaks free. The baby bird's tools consist of an "egg tooth," a horny projection on the top of the bill, and a strong "hatching muscle" located on the back of the head and neck, which sharply pulls the head upward and forces the egg tooth against the shell. By rotating its body within the shell each time it thrusts against the enclosing walls, the hatching bird makes a ring of tiny cracks around the egg's blunt end. Eventually, it creates a portal to the world, through which it bursts into the light.

The first breaking or "pipping" of the shell may occur many hours or even days before the chick finally emerges. Ovenbirds take 15-20 hours between pipping and hatching, wood thrushes 5-22 hours, Canada geese about 24 hours, and American coots 12-76 hours. And some seabirds, such as albatrosses and shearwaters, require as much as four days to break free of the egg. Bird eggs may seem fragile to humans, but to their occupants they present life's first challenge.

Precocial versus Altricial Young

The young of grouse, woodcock, and ducks are highly developed by the time they hatch. These "precocial"



Using an "egg tooth," a hatching bird pecks from inside the egg, rotating its body with each thrust until a ring of tiny cracks surrounds the egg's blunt end. Eventually — hours or even days after beginning — the chick emerges.

young come into the world alert, with their eyes open. Sporting a full coat of downy feathers, they are able to run or swim within an hour or two after hatching. The egg of precocial species contains such a generous quantity of yolk that their young hatch out with several days' food supply still present in their rounded bellies. This gives the parent enough time to lead her brood to a good feeding area, before the young become weak with hunger. Precocial babies are capable of some astonishing feats in their first few days outside the egg. A mallard brood may have to walk a mile or more from the nest to the nearest water where the young can find food. Many sea ducks launch their day-old broods from their isolated nesting islands into rough seas. With waves far above their heads, members of the tiny flotilla paddle furiously for hours or days to reach the calm, shallow bays where the ducklings can catch amphipods and other nutritious invertebrates.

Young of songbirds, hawks, and owls, on the other hand, are weak and totally nest-bound during their first few days or weeks of life. These helpless, "altricial" babies are completely dependent upon their parents for food and protection. Most are born naked (although young hawks and owls are downy), and writhe awkwardly into the world with their eyes tightly closed (except in hawks). The eggs of altricial birds also contain much less yolk than those of precocial species. Consequently, at the time of hatching, altricial young have only a few hours' food reserve. The parents' feeding responsibility begins almost immediately.

Grouse chicks, being precocial, are born with a protective downy coat and are able to follow along behind their mother and feed on their own almost immediately after hatching.

Feeding the Young

In precocial birds, the parent will point out appropriate food items to the young, or the brood may peck at various objects in trial-and-error fashion until they learn which items are palatable and which are not. The adult takes little active role in feeding except to lead its young to a suitable area.

The vast majority of young birds are fed directly from the bills of their parents. Within a few minutes of hatching, the helpless nestlings of altricial species are able to raise their heads, open their gaping mouths in the typical food-begging pose, and emit weak call notes. The adult bird responds by thrusting the food item it has gathered deep into the nestling's throat, where the swallowing reflex takes it the rest of the way down. In many birds, the parent swallows the food it collects, and regurgitates it into the mouths of the young. This allows the adult to carry more food in a single trip, and starts the digestion process even before the baby receives it. Gulls regurgitate on the ground and let the young help themselves. Young pelicans and cormorants thrust their entire heads down the adult bird's throat to retrieve food items directly from the gullet. The parents calmly permit and, in fact, encourage this dangerous-looking but entirely natural practice.

The diets fed to most young birds by their attentive parents consist of food items that are high in the protein needed for rapid growth. This means that even seed-eating species, like sparrows and finches, gather mostly insects and other invertebrates for their nestlings. As much as 95% of a young cardinal's diet is insects, while adult birds eat mainly seeds and fruits. Insect-eating birds, such as most warblers, generally feed insects to their young, while flesh-eating species feed that to their young. Hawks and owls bring whole prey animals, typically mice and small birds, to their nests, where the female tears off bite-sized portions and offers them to her anxious offspring. When the nestlings get a little larger, the adults simply deposit dead prey animals in the nest and let the youngsters divide the bounty and feed themselves.

Pigeons and doves have a unique system for feeding their young. The adult bird produces a "milk" by repeatedly shedding the fatty cells that line its crop, a special section of the bird's esophagus. Pigeon's milk is rich in protein and fat, and is regurgitated into the waiting mouths of the altricial young. Adult birds produce milk for about 18 days, but after the first five days, the parents supplement their offsprings' liquid diet with partially digested seeds.

Most young birds get the water they need in the moist food they eat, but some birds, such as ravens, carry water to their nestlings in their mouths. Some desert-dwelling species soak their belly feathers in shallow pools before returning to the nest. This technique helps to keep the young cool on hot days, as well as providing needed drinking water.

It takes a lot of food to satisfy a hungry brood of rapidly growing birds, and that means that the parents are kept busy throughout the time their young are in the nest. Birds that capture large food items make relatively few feeding trips to the nest each day. Bald eages bring food only four or five times per day, while barn owls deliver prey to the nest about ten times a night. The small insectivorous birds, however, spend most of their waking hours gathering and delivering food to the young. Most songbirds make four to twelve feeding trips per nestling per hour. One male house wren in Illinois that had apparently lost its mate averaged one food delivery every 47 seconds for a total of 1,217 feeding trips in a single day. During the period of most rapid growth, nestling birds often eat more than their own weight in food each day.

Cleaning Up After the Young

Birds that produce precocial young generally leave the empty eggshells in the nest when they depart with their new broods. But altricial species either eat the shells or carry them far enough away from the nest that they will not attract predators.

When baby birds are confined to a tiny nest for days or weeks on end, an efficient system of nest sanitation becomes very important. Rotting fecal material could harbor diseases and parasites that attack the young, and

Altricial young, such as these gray catbirds, are helpless upon hatching, completely dependent for weeks upon their parents for food and protection, until they become more fully developed.

Songbirds have developed a waste-disposal system in which the nestlings' feces are enveloped in fecal sacs which the parents regularly remove from the nests.

accumulating "whitewash" could make a nest very conspicuous to roving predators. To avoid these dangers, songbirds have evolved a waste-disposal system in which the nestlings' feces are enveloped in a tough, clean membrane or "fecal sac." When the adult delivers food, it also collects the fecal sacs and either eats them or carries them away from the nest. Some of the larger birds of prey, such as hawks and eagles, which have little need to conceal the location of their nests, simply back up to the nest rim and shoot a stream of liquid feces over the edge. Adult birds will usually remove infertile eggs from the nest, and will even carry off dead nestlings and drop them some distance from the nest.

Protecting the Young

When a wandering house cat, curious birdwatcher, or other potential enemy approaches the nest, the young will quickly hunch down below the nest rim. Older nestlings in ground nests may duck for cover in adjacent vegetation, then freeze in place to avoid attracting attention. If the parents are nearby, they may attack by dive-bombing or screaming at the intruder. Attacks by gulls and many hawks are so vigorous that they have caused serious scalp wounds on people who tried to see their young. In flushing from their nests when surprised by a predator, many waterfowl make their eggs less desirable by defecating on them.

Many ground-nesting species have developed "distraction displays" that they use to lure away an approaching predator. Commonly, the bird stumbles along the ground, dragging one wing in a convincing imitation of a debilitating injury. The bird continues its display, leading the intruder farther and farther from the nest, until it is miraculously cured and flies off. Waterfowl are particularly adept at distracting enemies, and the killdeer's broken-wing display is one of nature's finest acting jobs.

Some potential threats to nests, young, or the birds themselves are dealt with by collective action. Groups of smaller birds will band together temporarily to chase and dive at the common enemy. The perceived danger, which might be a hawk, a snake, or even a human, is mobbed by the determined defenders. Through mobbing, they attempt to drive danger away. In another type of group defensive activity, a flock of birds will bunch together if they are under attack. Apparently, individuals become less vulnerable to airborne predators if they close their ranks.

A few birds are known to carry their young away in the event of danger, although this behavior is not common. Several species of grebes, ducks, geese, and swans have been observed swimming with their precocial young on their backs, and some shorebirds may fly away with their chicks, one at a time, clamped firmly between their dangling legs.

Time to Leave the Nest

Many altricial birds stay in the nest about the same length of time that they spend in the egg, about 12-18 days for the great-crested flycatcher, 9-12 days for the horned lark, and two weeks for the evening grosbeak. On the other hand, sparrows spend less than 10 days in the nest, while young purple martins stay in their nesting boxes up to 5 weeks. Although the martin's nestling period is unusually long, most hole-users occupy their safe and secure nesting cavities longer than open-nesters stay in their more vulnerable nests. Ground-nesting birds as a rule are the earliest to depart.

Even before they are able to fly, many birds leave the confines of the nest to scramble among the branches of trees or shrubs, or to hop around on the ground. It is not at all unusual to see flightless young robins and other birds roaming free in your backyard or elsewhere. They are usually attended closely by their parents, who attack or scream at anyone who ventures near their babies.

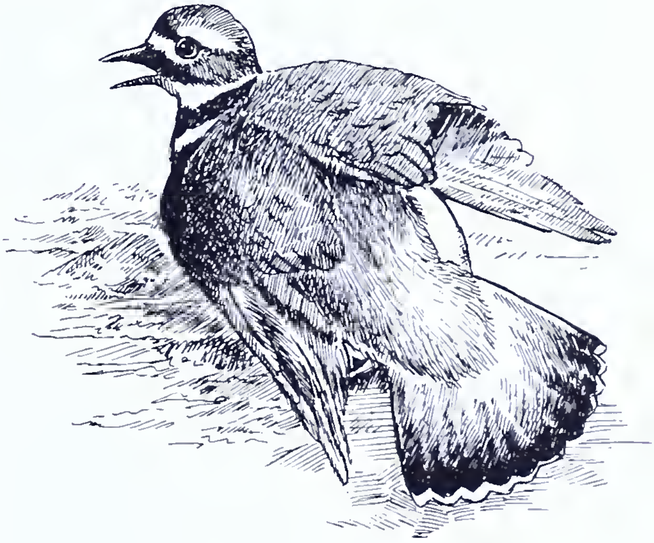
Some birds may have to force their young from the nest by refusing to feed them until they leave it. Once they do, the parents may feed and care for them for days or weeks, until the growing offspring gradually become independent. In this time, the fledglings develop their flying skills and may learn the rudiments of food gathering from their parents. Adult kingfishers may help their young develop their fish-catching dive by capturing and handling a fish until it is sluggish, then releasing it for the young to catch. In the same way, some hawks deliver injured prey to their fledged young, who then must capture and kill the food themselves.

A New Coat of Feathers

After the stress and bustle of the breeding season has ended, and before many species embark on their physically taxing migrations, Pennsylvania's birds take time off to don a whole new covering of feathers. Depending upon the species, birds may replace, or "molt," their feathers once, twice, or more times each year. But the post-breeding molt is most important because, in nearly all species, it is a complete molt of the bird's entire plumage including body feathers, wings, and tail. Many species go through a second partial molt of just their body feathers in the spring immediately before breeding. During this prenuptial change of clothing, the bird may put on a colorful courtship plumage which it wears only during the breeding season. The American goldfinch, a year-round resident of Pennsylvania, molts twice each year. The transformation is so complete that the striking yellow-and-black male goldfinch of summer hardly resembles his drab greenish-gray winter form.

Some birds develop a showy and conspicuous breeding plumage without any prenuptial molt at all. Instead, their brighter colors and conspicuous patterns are formed by abrasion of feathers the bird has maintained since

Many predators — and curious young boys, too — have been fooled by the injury-feigning tactics of the killdeer. The bird acts as if injured, but stays just out of reach while enticing intruders away from its young.



Redheads, by John Sidelinger. Redheads may be found on lakes and ponds throughout the year, but are most often seen during the spring and fall migrations.

Canvasbacks, by Kent Pendleton. Canvasbacks are noted most for their sloping bills. These diving ducks are also commonly seen in Pennsylvania during migrations.

Mallards, by Ned Smith. Mallards are abundant throughout the state at all times of the year.

Hooded merganser, by Randy Rowe. The smallest of the three species of mergansers, this species is readily distinguished by its conspicuous white hood.

Northern pintail, by Jim Landenberger. The pintail is the most widely distributed duck in North America and a common migrant through this state.

Wigeons, by Ned Smith. Wigeons, often called baldpates, may be seen flying in small dense flocks.

Wood duck, by Jerry Putt. Considered by many to be the most attractive species of waterfowl, the colorful wood duck—being chased here by a peregrine falcon—was once nearly extinct, but today is the most abundant breeding duck in eastern North America.

Green-winged teals, by Ron Jenkins. One of the first spring migrants to appear in the state, this species is often seen on small bodies of water.

John Sidelinger

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RANDY ROWE

J.F. LANDENBERGER

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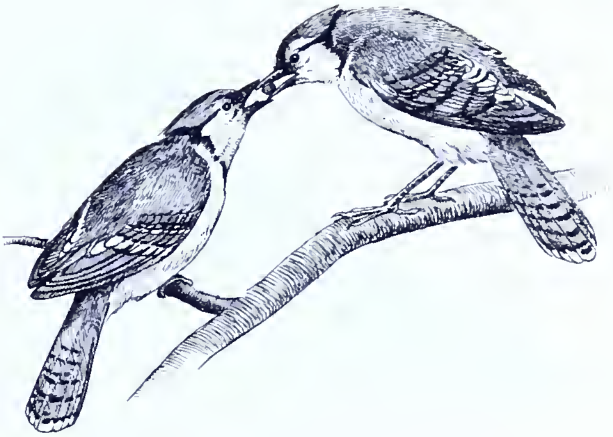
Some birds continue to feed and care for their young after they have left the nest, providing them with additional time for learning how to fly and care for themselves.



the end of the previous breeding season. During the winter, for example, gray feathers on the breast of the male house sparrow gradually wear away, revealing the prominent black bib of the bird's breeding plumage. The striking black-and-white nuptial raiment of the bobolink develops through the gradual loss of the yellowish tips of the bird's winter feathers. And the speckled courting attire of the starling appears when the edges of its dark winter feathers are sufficiently abraded.

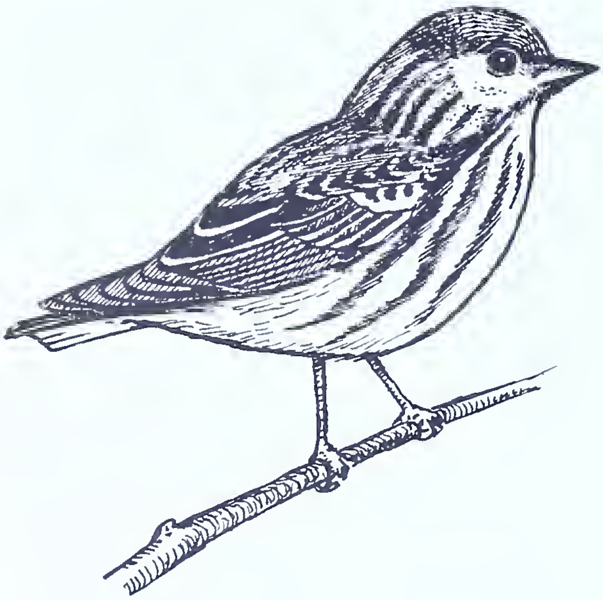
In the majority of birds, the molting of feathers occurs so gradually that there is little disruption of the bird's normal activities, and there may be little change in the bird's appearance. The critical flight feathers on the wings and tail drop out in sequence, one or two at a time, and new feathers replace them rapidly enough that the bird never loses its ability to fly. The molt is symmetrical on each side, so the bird is never out of balance. The loss and replacement of body feathers may be somewhat patchy, however, so it is not unusual in late summer to see a cardinal or other bird with a naked head. There is little doubt that even this sequential molt affects the mobility and agility of birds. Many species become much more secretive in their activities during the time that their plumage is being renewed.

Rather than molting in the sequential pattern of most songbirds, waterfowl lose all the primary feathers on their wings simultaneously, rendering them flightless until the new feathers grow out. Male ducks abandon their mates during incubation and fly to large, isolated bodies of water where they can molt in relative safety. At the time they molt their flight feathers, ducks acquire a drab body plumage often called their "eclipse" plumage. They wear this inconspicuous covering for only a few weeks. Once their wing feathers are fully developed, they undergo an early prenuptial molt that replaces just the body feathers and renews the bird's brilliant breeding plumage. Female ducks delay their post-breeding molt until the ducklings are nearly independent.

Many small birds attain their adult plumage with their initial molt at the end of their first summer. But some of the larger species, notably gulls, wear a recognizable subadult plumage for one or more years before they acquire the characteristic garb of adult birds. A bald eagle waits four or five years to develop the white head and tail that identify it as an adult.

Migration

As the long days of summer gradually shorten toward fall, many of Pennsylvania's feathered residents start making preparations for the annual southward journey to their winter quarters. Under the influence of changing hormone levels in their bodies, they begin to take on fuel that they will burn on their long, migratory flights. Some birds accumulate enough fat to double their post-breeding body weights. The blackpoll warbler, a common migrant through Pennsylvania, increases in weight from 11-12 grams



The blackpoll warbler, a common migrant through Pennsylvania, nearly doubles its weight — from 11 or 12 to up to 23 grams — immediately before beginning its transcontinental flights.

during the breeding season to 20-23 grams or more immediately before migration. Our smallest migrant, the tiny ruby-throated hummingbird, might accumulate two grams of fat, increasing its body weight to a hefty 4.5 grams. Although the quantity of fat seems small, it is more than enough to carry the hummingbird on a nonstop flight across the Gulf of Mexico.

Not all of Pennsylvania's birds are migratory. Ruffed grouse, ring-necked pheasants, bobwhite quail, and wild turkeys may spend their entire lives within a few miles of their birthplace. Five species of owls (barn, screech, great horned, barred, and long-eared) are generally thought to be sedentary, although some barn owls have been known to make occasional long-distance movements. Pileated, hairy, and downy woodpeckers are also very localized in their movements, as are the introduced rock dove (common pigeon), house sparrow, and starling. In addition, ravens, black-capped and Carolina chickadees, tufted titmice, white-breasted nuthatches, house finches, and cardinals are usually nonmigratory.

Some species that are present in Pennsylvania year-round are, in fact, migratory. The blue jays that raise their young in your backyard are not the same birds that fight for corn at your winter feeder. The jays that breed here move south for the winter and are replaced by birds arriving from the north. In the same way, migratory crows and song sparrows can be found in Pennsylvania at any time of the year. Like passengers at the airport, the crowds are always there but the individuals are different.

The majority of our birds are visitors that are present only in the appropriate season. House wrens and broad-winged hawks are strictly summer residents, while tree sparrows and rough-legged hawks prefer the Pennsylvania winters. Neither breeding nor wintering here, Tennessee warblers and pectoral sandpipers are seen only in transit during their fall and spring migrations.

Strange Ideas about Migration

It has been known from earliest times that certain bird species disappear for part of the year. Where do they go? More than 2,000 years ago the Greek philosopher and naturalist Aristotle wrote of the seasona movements of cranes, geese, and other birds, telling how they traveled to more hospitable areas to spend the winter But Aristotle also suggested that many birds hibernated during winter in hollow trees and caves, or buried themselves in the muck of swamps and marshes. To explain the seasona disappearance of some species and the arrival of other species at about the same time, Aristotle suggested that many birds transform themselves into another species for part of the year Thus a bird may take on the form of a house wren in summer and a tree sparrow in winter, spending the whole year in the same area.

Other early "naturalists" went too far in the opposite direction, suggesting that many birds were capable of astounding migrations, even so far as spending the winter on the moon! Although many people were willing to accept the possibility of long migratory flights by large birds, they were unable to believe that small birds could perform similar feats. In some areas of the world it is still thought that small birds are carried on their migrations by larger ones. And in North America, Indian legends tell of wild geese that carry hitchhiking hummingbirds on their backs.

Today we know that birds do not hibernate (although certain hummingbirds and swifts become torpid on cold nights), nor do they need help from others to make long migratory flights. They need only the power of their own wings and the energy stored in a few ounces of fat.

Why Do Birds Migrate?

Birds would not risk the considerable hazards of migration if it were not to their advantage. The benefits of migration must outweigh the obvious risks.

The primary impetus for migration in many species seems to be to take advantage of food supplies that are plentiful during only part of the year. Birds journey south in the autumn as the lush blooms of insects, seeds, and fruits begin to fade in the north. And they return in spring to reap the new year's harvest. Cold temperatures alone are not enough to force our summer residents south. As long as sufficient food is available to stoke the internal fires, birds are capable of withstanding the coldest winters. In addition, it may be advantageous to breed in northern latitudes because there are fewer predators and more space than in the tropics.

The Timing of Migration

Different species migrate at different times of year, so that in Pennsylvania there are migrants moving south from July through November, and north from February through early June. Among our earliest fall migrants are the shorebirds, such as the solitary and pectoral sandpipers, which breed farther north and begin their southward journey about the same time that our resident goldfinches are just starting to nest. But the majority of autumn migrants pass through the state from late August through October.

Robins and red-winged blackbirds are among the first birds to arrive in Pennsylvania in spring, often while there are still several inches of snow on the ground. Many waterfowl, ring-billed gulls, American woodcock, horned larks, eastern bluebirds, and song sparrows also arrive in February and early March, while our year-round resident great horned owls choose this unlikely time to start their early nests. The middle of May marks the peak of spring migration through Pennsylvania.

Once a bird is physiologically prepared to migrate, it takes favorable weather conditions to trigger its departure. For fall migrants, a common stimulus is the approach of a high pressure air mass from the west. Preceeding this air mass, there is generally a cold front, whose turbulent winds keep most birds on the ground. But once the cold front has passed, birds depart in a wave, taking full advantage of the clearing skies and southerly flow of air produced by the approaching high-pressure area. Thus the best time to look for migrating birds in autumn is a day or two after a cold front has passed by. During spring, low-pressure areas arising in the Gulf of Mexico produce warming temperatures and a northerly flow of air that speed our migratory birds toward their breeding areas.

Deteriorating weather, particularly rain and fog, can bring migrations to a halt. Birds that have been caught in storms and fog are often killed by flying blindly into buildings, radio and television transmission towers, lighthouses, and other manmade obstructions, or by simply colliding with each other. Rain- and fog-bound waterfowl often put down in parking lots and on highways, mistaking these wet surfaces for the open water of lakes and streams.

Most of our smaller migrants, the warblers, sparrows, vireos, thrushes, flycatchers, woodcock, and rails, choose the night for their lengthy travels, as do many waterfowl. They may spend the day foraging furiously to replenish their energy reserves before their next flight. During spring and fall, it is common for an area of habitat to be empty of birds one day and filled to overflowing the next, due to the arrival of migrants during the night.

Not all birds are nighttime travelers. Loons, cranes, some ducks and geese, gulls, hawks, hummingbirds, swallows, nighthawks, and swifts usually migrate by day. Swallows and swifts feed on the wing by sweeping insects out of the air. Many hawks migrate on cushions of warm rising air, called thermals, that only are present when the sun is out.

Migration Speeds and Altitudes

The waves of migratory birds that advance across the landscape in spring and fall generally move much more slowly than the birds themselves are capable of flying. Migrants may spend several days at a stopover location before moving on. Also, the advancing front of birds in spring may change in makeup, as the earlier migrants settle into their more southerly breeding areas and are leapfrogged by later migrants who push farther north.

By following migratory flights of birds with radar or by other means, scientists have measured some typical traveling speeds. Shorebirds, ducks, and geese fly at roughly 40 to 50 miles per hour, while hawks, herons, ravens, shrikes, and many songbirds cover 20 to 30 miles per hour. At these speeds, sustained flights of more than 1,000 miles per day seem possible for some waterfowl. Yet there are few actual records of banded ducks having covered 1,000 miles in less than two weeks. One fast-flying blue-winged teal flew 3,800 miles in a month.

Our smaller songbirds generally fly between 60 and 200 miles per day, but may take stopovers of varying lengths. Rate of travel also can vary as the birds proceed on their journeys. On its northward migration, the little blackpoll warbler maintains a leisurely pace of 30 to 35 miles per day between the Gulf of Mexico and Minnesota, then accelerates to as much as 200 miles per day in its headlong rush across Canada to its Alaskan breeding grounds.

The altitudes at which birds fly during migration vary considerably among species. Although some geese have been observed flying at more than 25,000 feet over the Himalayas, radar studies show that roughly 95 percent of all migratory flights are at altitudes less than 3,000 feet. The majority of small birds travel at 500 to 1,000 feet above the ground, but some night-flying shorebirds have been observed over the ocean at 15,000 feet or more. A few species, such as sea ducks and some shorebirds, fly so low across the water that they barely clear the wave crests.

How Do They Find Their Way?

In its annual migratory travels, a tundra swan may move thousands of miles between its breeding area on the Alaskan or Canadian tundra to its eastern wintering area in the fingers of Chesapeake Bay. Yet in spring it returns unerringly to its northern breeding grounds, often to the same tiny islet within a shallow lake where it nested the year before. Such incredible feats of direction-finding are common in the bird world, where even the smallest migratory songbird may return faithfully to a postage stamp nesting area each year for as long as it lives.

Under the right conditions, it's not unusual to see migratory flocks against the face of a bright moon. Some species migrate by day, others by night, and they evidently use many different cues to travel to and from breeding and wintering areas.

Karl Maslowski

Birds are known to use many different cues to find their way. Some simply guide themselves using prominent landmarks, such as river valleys or coastlines. This is clearly the method used by the common eider ducks that nest on islands in the St. Lawrence estuary of Quebec and spend the winter off the coast from Maine to Massachusetts. These birds faithfully follow the long, jutting coastline of Nova Scotia, even though the wintering area is 400 miles closer by an overland route.

Many diurnal migrants use the sun to determine the proper direction to fly, and nighttime migrants use the stars. To use these celestial guideposts effectively, the birds possess an accurate internal clock that allows them to correct for the daily movement of sun and stars across the heavens. On cloudy days when the sun and stars are invisible, many migrants become disoriented and must pause in their travels or switch to another method of finding their way.

Some birds even use the earth's magnetic field like a gigantic compass to guide their migratory flights. In one experiment, pigeons carrying tiny magnets glued to their backs could not find their way back to the loft under overcast skies. They became lost because the magnets disrupted their ability to detect the earth's magnetism.

From studies like these, it has become clear that birds take advantage of many different cues to guide their migrations, and that different species may use different roadmaps. An unanswered question is how young birds traveling alone can find their way when they have never followed the route before. Although some birds may learn the way by following their parents, others must inherit an internal map that allows them to navigate correctly and independently the first time they try.

Migration Routes

Early studies of the migratory movements of North American ducks prompted waterfowl biologists to divide the continent into four broad north-south "flyways" — the Atlantic, Mississippi, Central, and Pacific. It was thought that these units represented major migration pathways and that there was little interchange of ducks between flyways. The flyways are still used by the U.S. Fish and Wildlife Service as administrative areas for waterfowl management.

It has recently become clear that the vast majority of birds, and even many waterfowl, are completely oblivious to the flyways that man has drawn across the landscape. Instead, the continent is crisscrossed by an extremely complex pattern of individual migration routes that vary from species to species and place to place. Even for waterfowl, the flyway concept has been replaced by a network of migration "corridors," perhaps 200 miles in width, that are used by different numbers of birds. The waterfowl population of a given area probably uses the same migration corridor every year.

Although many species make a relatively simple north-south migration, some make extensive east-west movements. Redhead ducks that breed in the marshes around Great Salt Lake in Utah spend the winter on the Atlantic coast, and tundra swans may cross the continent from Alaska to Virginia. Other species follow a circuit, traveling different routes in fall and spring. The Connecticut warbler is one of these, passing through Pennsylvania on its southward migration in fall, but following the Mississippi Valley in spring.

Winter

With the end of the breeding season in Pennsylvania and the approach of fall and winter, the behavior of most birds changes radically. Birds that had been aggressive defenders of their territorial holdings, intolerant of others of their own kind, suddenly feel the need to seek out other members of their species and live a more communal existence. During the breeding season birds were evenly distributed over the landscape, for the territorial systems of many species kept them spaced out within their favored habitats. Furthermore, the movements of each bird were highly localized — the territory was a prison for its occupants as well as a fortress against intruders. But as the breeding season comes to a close, birds abandon their territories, join together in single- or mixed-species flocks, and wander across the landscape like gypsy bands. In autumn, the migrants depart for their alternate homes in the south, while others arrive from nesting grounds farther north. As autumn passes, the winter visitors mingle with the year-round residents, sharing in their nomadic winter lifestyle.

Some birds maintain a solitary existence throughout the year. Some woodpeckers, hawks, and owls are among nature's loners. Other species may wander about in family groups, or aggregate with other families to form small flocks. In Pennsylvania, the largest winter aggregations of birds are the roosting assemblages of common grackles, red-winged blackbirds, starlings, and cowbirds that form primarily in the southeastern counties. One winter roost in York County has sometimes contained up to 10 million birds.

The primary activity among wintering birds is food gathering, and the flocking habit offers some advantages. Flocks move freely over the landscape, generally unrestricted by territorial boundaries, and thus are able to find and exploit widely scattered food resources. With more birds looking, flocks may also be more efficient at food finding, locating feeding areas that an individual might have missed. For the same reason, flocks are also more effective in detecting predators and sounding the alarm. Studies have shown that individual birds spend much more time looking for danger when they are alone than when they are members of a flock. With more pairs of eyes, the flock can keep a sharp lookout while its individual members spend more of their valuable time and energy feeding. By adopting the flocking habit, more birds may survive until spring comes again.

How Many Years Do Birds Live?

There are several answers to the question "How long do birds live?" Birds kept in zoos and aviaries, where they are fed regularly, sheltered from harsh weather, and protected from diseases, parasites, and predators, live much longer than their wild cousins. Captive birds probably approach their genetically programmed maximum potential life spans.

Even under these ideal conditions, small birds live much shorter lives than large birds. For example, a captive American goldfinch lived 13 years, a cardinal 28 years, and a U.S. Army homing pigeon 32 years. Captive Canada geese have lived more than 40 years, a herring gull nearly 50 years, one common raven 69 years, and a great horned owl about 100 years.

Free-living birds rarely even approach these age records. Few wild birds die of old age. Instead, they succumb to injury, disease, predation, migration hazards, winter food shortage, or, in the case of game birds, the hunter's gun. Information on longevity of wild birds comes mainly from recoveries of banded individuals. Many birds will return to the same banding location each year for as long as they live. Bands put on game birds, such as waterfowl, are often recovered by hunters. Occasionally, banded songbirds are killed when they strike windows or are hit by cars. Band recoveries from dead songbirds are relatively rare.

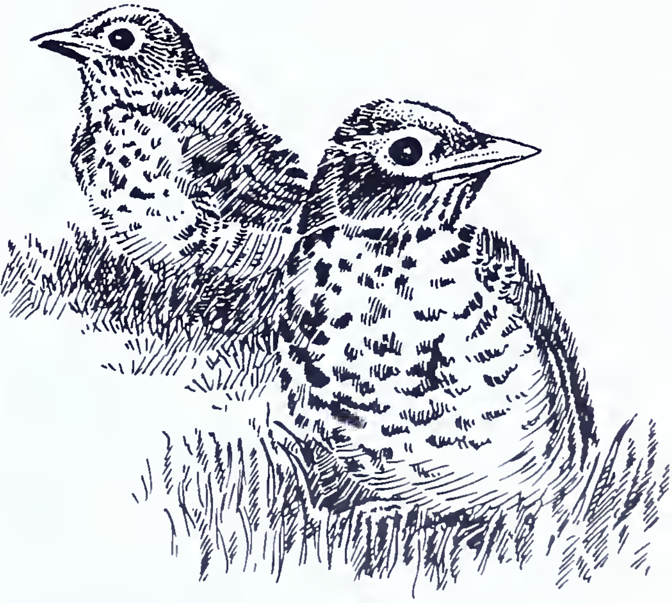
Banding records show that brown creepers, eastern bluebirds, purple martins, and house wrens may live 5-8 years in nature. Cardinals, gray catbirds, mourning doves, evening grosbeaks, American robins, and blue jays live 10-15 years. Canada geese, ospreys, golden eagles, and mallards are known to have lived more than 20 years in the wild.

Although maximum life spans are interesting statistics, a more important value affecting a population's size and growth rate is the average life expectancy of individual birds. Life expectancy is the number of years a newly hatched bird can expect to live in the face of all the hazards in its enviroment. For small birds, the average life expectancy in the wild is often less than one year.

Mortality rate and life expectancy are two sides of the same coin. Mortality rate is the percentage of a bird population, or a particular age group, that dies each year. If the mortality rate is high, then average life expectancy will be short. Mortality rates vary with species, geographic location, and age and sex of the bird.

Mortality rates are generally higher for juvenile birds than for adults, but the magnitude of this mortality may vary from year to year depending upon weather conditions or food supplies. It is not uncommon for 60% of juvenile songbirds to die before the end of their first year of life, while 40-50% of adults may die each year. At these rates, only one or two birds out of 100 would be expected to live as long as 6 years.

In general, the larger the bird, the lower its average mortality rate and the longer its life expectancy. Adult royal albatrosses have a mortality rate of about 3%, one of the lowest known for a wild bird. Adult mortality rates average 30-40% for most hawks, owls, and gulls; 40-50% for blue jays, robins and other medium-size birds; and 50-70% for song sparrows, starlings, and other small songbirds.



ORIGINS AND ADAPTATIONS FOR FLIGHT

How Birds Evolved

As children, we all were terrified and delighted by tales of the dinosaurs that stalked the primeval earth. Once the undisputed rulers of the world, these huge reptiles vanished more than 60 million years ago, the victims of cooling climates or other environmental changes to which they could not adapt. Not all dinosaurs were monsters like the Brontosaurs or Tyrannosaurs of our childhood fantasies. Many were small creatures with delicate skeletons that used their hind legs to scurry through the undergrowth, avoiding their rapacious kin.

It was once thought that the dinosaur line faded completely, leaving no modern descendents. Now there is evidence that at least one branch of this line survived, producing descendents that have successfully colonized nearly every environment on earth. These modern-day dinosaurs we know as birds.

It has been known for over a century that birds descended from reptiles. In 1861, a Bavarian limestone quarry yielded the fossil remains of the oldest known bird. Called *Archaeopteryx,* this crow-sized creature had reptilian teeth in its bony jaws, clawed fingers protruding from its wings, and a long, lizard-like tail. It might have been mistaken for one of the smaller reptiles of its time except for one thing — the fossil possessed beautifully preserved imprints of feathers.

It is another characteristic of *Archaeopteryx,* warmbloodedness, that indicates it descended from the group of reptiles we call dinosaurs. Although other reptiles are coldblooded, their body temperatures varying with environmental temperatures, the dinosaurs appear to have been warm-blooded creatures, able to regulate their internal warmth at a constant elevated level. This is a trait that the dinosaurs passed on to their avian descendents.

Despite its feathers, *Archaeopteryx* probably could not fly on its inadequately formed wings. A brief glide from one tree to another may have been the limit of its aerial capabilities. Instead, its feathers had evolved from reptilian scales primarily for insulation to help maintain its high body temperature and prevent the loss of heat to the environment. Only later, together with changes in the structure of the wings and other body parts, were feathers adapted for use in flight.

Archaeopteryx lived about 140 million years ago. From this modest beginning, birds evolved rapidly in the geologic scale of time — by 25 million years ago, most of our modern bird families were already in existence. Through the ages, nature experimented with many bizarre and fascinating forms of birds that are now extinct. Toothed birds existed at least 50 million years after *Archaeopteryx.* North America once hosted a flightless, predatory bird that stood taller than a man, and a vulture-like soaring bird with a 16-foot wingspan. As new species arose, others became extinct when they could no longer compete successfully for the resources they required. There are about 8,600 species of birds in the world today, but there may have existed as many as one million different species since nature's first experiments with birds began. Most of these arose, flourished briefly, then vanished from the earth. The process of extinction is not a new one — extinction of species is as natural as the death of individuals. But today there is cause for alarm, because the rate of species extinction has accelerated during recent times as man has altered the habitats they need to survive (see Bird Conservation and Study).

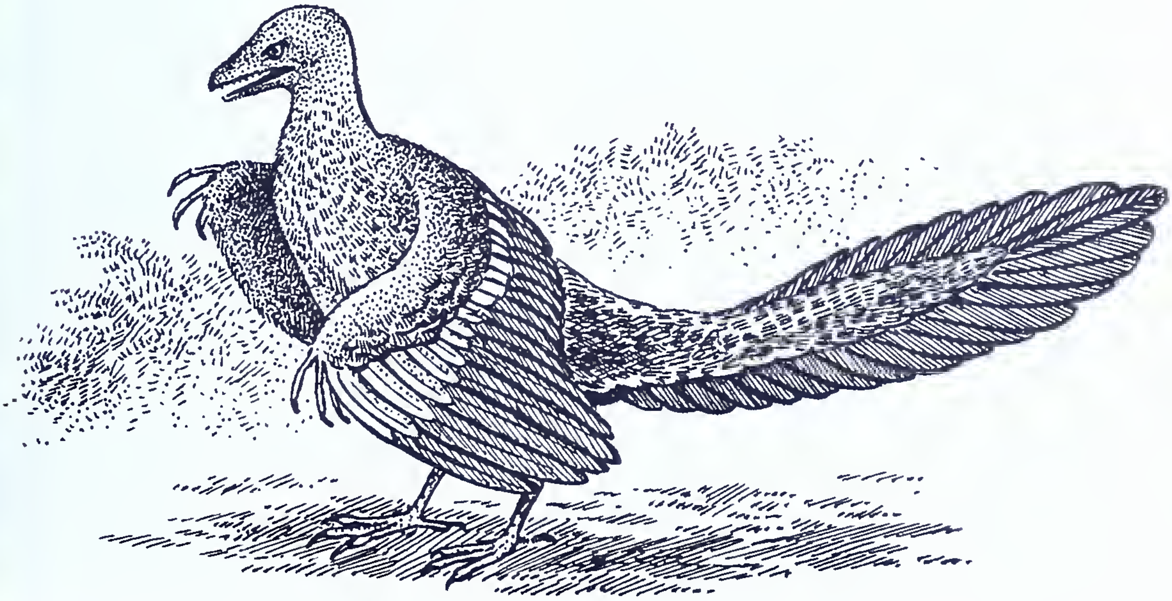
The Physics of Flight

Flight is not magic. A bird's body parts, the tangible structures that permit it to fly, are living examples of the laws of physics governing all motion.

For many song and gamebirds, wingbeats provide the initial forward motion required for the bird to become airborne. In basic flapping flight, the long outer feathers of a bird's wings — the primaries — push the air with great force. Like the blades of a propeller or an electric fan, they shove the air backward and thus propel the bird forward. Once the bird is in motion, the aerodynamic shape of its wings is all-important for lift, like the wings of an airplane. They rely on a difference in air speed above and below the curved wing surface. This difference provides the lifting force needed to keep the bird aloft.

Because of their greater body weights, larger birds need larger wings to remain airborne. They also need to fly faster to produce enough lift. Some birds are so heavy that they can't take off simply by flapping their wings. Instead, they must run along the ground, like the turkey vulture, or patter across the water, like geese and grebes, to launch themselves into the air.

Archaeopteryx is the oldest known bird, having lived about 140 million years ago. The fossil remains of this crow-size animal have many characteristics of its reptilian ancestors—teeth, clawed fingers and a long, lizard-like tail—but they also show the earliest evidence of feather development.



Standard Equipment

The phyical similarities among almost all families of birds are remarkable. Among flying birds, there is far less divergence in appearance than there is, say, among mammals. This uniformity is caused by the nearly universal adaptation among birds to a flight design. Wings alone do not permit flight. Birds must be consistent, perfectly orchestrated, flying machines. For birds, flight design has many components. In addition to the wings themselves, feathers, hollow bones, a warm body temperature, and many other elements are necessary to the total package.

A Special Skeleton

Most birds have extremely strong and resilient skeletons, that are made light in weight because individual bones are hollow (except in some diving birds). Strength is increased by a network of internal struts, much like those of a biplane or a bridge, which give maximum rigidity and resistance to breakage in strong winds, with minimum weight. Skeletons of birds also are strengthened by being simplified. Bones that would be separate in a reptile are fused together in birds, creating compact, hollow structures. The result is that bird skeletons are unbelievably light in weight relative to the size and mass of the bird. The frigatebird, a soaring sea bird with a 7-foot wing span, has a skeleton that weighs less than its feathers.

Another modification of bird bones allows them to utilize enormous wing muscles. Attached to the breastbone is a large flat keel, familiar to most people as the bony ridge that separates the two halves of the breast on a Thanksgiving turkey. This extra area for attachment of flight muscles is unique to birds, and is essential to their airborne way of life. Forty percent of the weight of birds which depend on flapping flight is accounted for by these immense muscles. Soaring birds have smaller breast muscles, but have larger and stronger tendons for holding their wings outstretched, which they may do for hours at a time.

Feathers

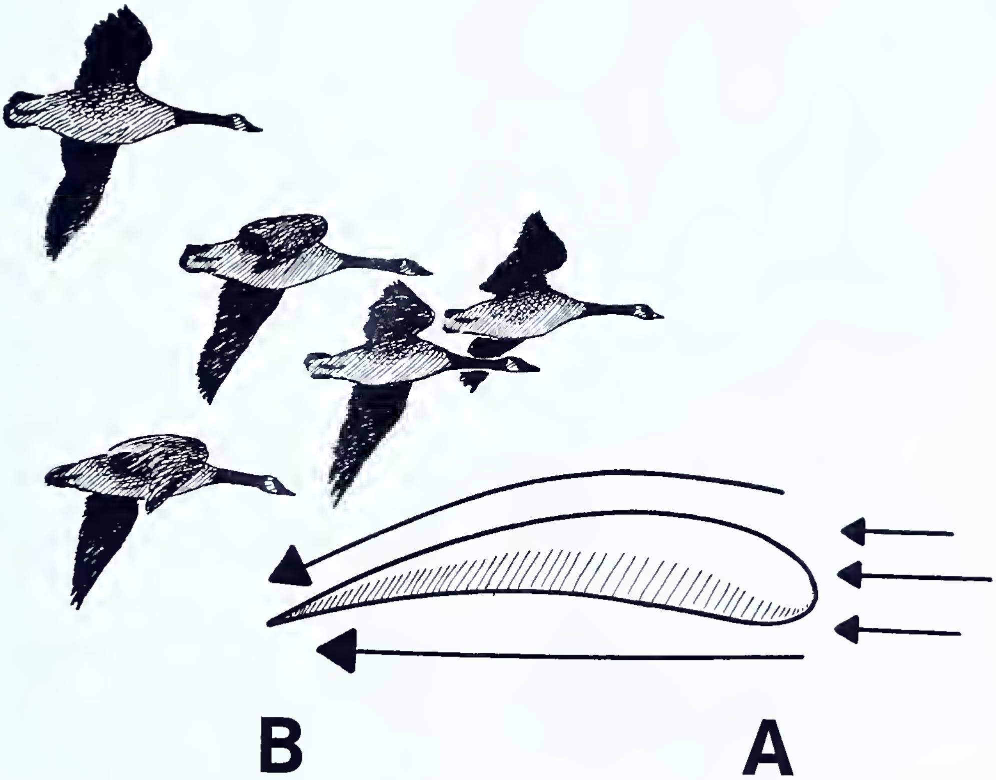
Feathers have many purposes. They act as insulation to prevent the loss of precious body heat, and they protect the bird's tender skin from harm. Their shape and color may help hide the bird from its enemies or attract a mate. But their most important role in the amazing success of birds is that they make flight possible.

Feathers produce the aerodynamic shape of a bird's wing that provides both lift and propulsion, and they streamline an otherwise ungainly body into a graceful projectile. Like the skeleton, feathers are hollow for light weight, but they are not made of bone. Rather they are built of a protein-rich substance called keratin, similar to fingernails. There may be as many as 25,000 feathers on a single bird.

Balance and Trim

Staying aloft requires these biological flying machines to have a center of gravity or balance lower than the level of wing attachment. To accomplish this, special branching air sacs are distributed carefully amid other body parts, even down to their toes, to maintain a proper distribution of mass. Birds also have no teeth. This means that they need no strong jaws or heavy heads, and no long, bony tails for counterbalance. The job of grinding their food has been taken over by a gizzard, a special organ located low in the body to keep the center of balance where it belongs.

Many birds have diminutive legs. These may be strong and well muscled, to support the bird when it lands, walks, or grasps, but they are constructed for minimum drag in flight. Long-legged birds commonly fold their



Flight is possible because of the properties of moving air. Air travels from point A to point B in the same amount of time, whether it goes over or under the wing. But the distance from A and B is greater over the wing, due to curvature of the air path. So the air over the wing must travel at greater speed to reach point B in the same amount of time as air going under the wing. Air moving at higher speed has lower pressure. The higher air pressure under the wing causes lift.

legs tightly against their bellies as they rise into the air, assuring stability. Tails are made almost exclusively of feathers. Useful as either rudders or brakes, these specialized feathers also can be spread to add to the lift provided by the inner wing.

Air Sacs and Respiration

A bird's air sacs are actually part of a unique and highly efficient respiratory system that supplies the body with life-sustaining oxygen. In man, as in other mammals, inhaled air enters the lungs and mixes with stale air left over from the last breath, reducing the efficiency of oxygen uptake by the blood. In birds, however, inhaled air flows first into an air sac, then *through* the small lungs into another air sac, before being exhaled. This system produces one-way flow of fresh air through the lungs, without any mixing of used and unused gases. Consequently, the bird's blood absorbs more oxygen than does a mammal's.

Breathing rates vary with the size of the bird and its level of activity. A turkey at rest may breathe only 16-18 times per minute, while a house wren takes about 80 breaths per minute. While in flight, some birds, like crows and pigeons, breathe once for every wing beat. But a lesser scaup averages in one minute more than 600 wingbeats and breathes only about 140 times.

Compact Reproductive Gear

Even the reproductive systems of most birds have been modified by the exclusive demands of the flying machine. For most of the year, especially during migration, body parts used in reproduction are greatly diminished in size. This, of course, also reduces their weight, and means that the birds are saved the effort of hauling around equipment they need for only a short time every spring or summer. Hormonal triggers, perfectly timed by a biological clock, enlarge the necessary organs at the proper moment, and quickly bring them up to functioning status.

The female's reproductive equipment has been further lightened by jettisoning half the tract. While mammals have two functioning ovaries and two oviducts, a bird has only one, usually the left. And by laying eggs, rather than bearing live young, birds have freed themselves of the burden of pregnancy, which would have interfered with the necessity of flight.

Fuel Efficiency

Birds eat only foods that are high in nutrients and energy. There are almost no grazing birds, few that tank up on coarse fodder and stuff that is tough to break down. That way, food never causes excess baggage and unneeded weight. To fire their rapid metabolisms and maintain their high body temperatures, birds burn their fuel quickly and efficiently. Residence time for food items in a bird's gut is only minutes in the smaller species, and there is very little waste. As much as 50 percent of the weight of food they eat may be converted into new body tissue.

Birds require food that is high in energy and easily digestible to fuel their high metabolisms and to keep excess weight at a minimum.

Karl Maslowski

During their migratory journeys, many birds burn up far more calories than they take in. They may remain aloft for days without replenishing their supplies. Weight loss ensues, the amount of weight reduction representing the fat reserves they have depended on to fuel their travel. Scientists have captured and weighed birds at both ends of these migratory marathons. The results of these studies show that birds use food energy with staggering, almost unequalled efficiency. A small airplane would have to achieve over 150 miles from a gallon of fuel, rather than their usual 15 to 20, to attain the efficiency of birds.

Sensing the World

For animals that can flit gracefully through the treetops, perform complex aerobatics, pick out food items at great distances, and make staggering cross-continent journeys, it is not at all surprising that most birds have excellent eyesight complete with full color vision. Compared with mammals, a bird's eyes are enormous — if a starling's head was the same size as a man's, its eyes would be fifteen times larger than his. Visual acuity in some birds is also remarkable; soaring hawks, such as our red-tailed hawk, have eyesight equivalent to that of a man using 8-power binoculars.

Although the demands of an aerial existence have produced excellent vision in birds, the role of smell has been greatly reduced in most species. The relatively stunted olfactory lobes of the bird's brain contrast greatly with the well-endowed visual centers. Despite this, some birds do use their

Being static soarers, vultures can often be seen gliding on air currents for long periods of time without the slightest movements of their wings.

noses to find food. This is true of turkey vultures that can quickly locate carrion that is hidden from view.

Along with vision, the sense of hearing is highly developed in most birds. This is not surprising given the great variety of songs, calls, and other sounds that birds use to communicate and, therefore, must be able to hear. A bird's ear is particularly sensitive to rapid sequences of different notes, which tend to sound blurred to humans. This may explain why humans have trouble telling many bird songs apart.

Individual Styles of Flight

Just as the bills of different birds have different shapes, so do their wings. The shape of a bird's wings varies according to its habitat and behavior. A bird that stays aloft by the differences in air currents over open water has no use for the well-developed muscles of flapping flight. Therefore, many water birds, such as gulls and terns and other dynamic soarers, have long, slender, pointed wings, and flap infrequently. Vultures, eagles, and some hawks are static soarers that ride on rising air currents produced by updrafts along Pennsylvania's ridges, or on thermals rising above the warm earth. This different kind of soaring requires a different wing, one that is broad and slotted for maximum lift and maneuverability.

Forest-dwelling birds tend to have short, broad wings, which allow rapid maneuverability in dense cover. The screech owl and many warblers show this adaptation. Birds of clearings, margins, and fields often need to make quick getaways, but seldom need to fly great distances. They tend to have broad, strong wings and specially shaped primary feathers, which permit speedy takeoffs and short bursts of flight. Anyone who has startled a grouse or woodcock has seen these birds explode into the air and away from danger.

Falcons and swifts are built for the extremely rapid flight required for their hunting methods. In its power dive, or stoop, the peregrine falcon screams out of the sky at 100 miles per hour or more. Swifts may be less spectacular, but still may attain over 70 miles per hour while plucking insects from midair.

Hummingbirds have truly unique wings. They can hold their bodies still while hovering or flying forward, backward, up, or down. Their figure-8 wingbeat pattern provides thrust on both the upstroke and downstroke, making them living helicopters. This spectacular performance requires unusually large flight muscles, coupled with the ability to flap more than 50 times each second.

In general, larger birds must fly faster than smaller ones to overcome gravity and wind friction to stay aloft. Of course, hummingbirds are an exception to this rule. Their method of flight is an exception to many rules. House sparrows are among the slowest of birds, usually traveling less than 20 miles per hour. Songbirds in general are limited to less than 40 miles per hour. Medium-size birds, such as crows and ducks, may fly at speeds of 30 to 60 miles per hour. Some shorebirds commonly exceed this speed, as do many falcons and hawks. A strong tail wind increases the ground speed of a bird flying long distances. During migration in favorable winds, some shorebirds have been known to average over 100 miles per hour for at least two days and nights.

Ostriches provide an interesting example of the greater speed required to keep large-bodied birds airborne. Scientists have estimated that ostriches would need to travel at least 100 miles per hour just to avoid crashing to the ground. It is not surprising that such a large animal, through thousands of years of changes, has lost the equipment for flight.

Through evolution, the avian body has been shaped primarily by the requirements of flight, just as the designer of an airplane is constrained in what he creates by the laws of aerodynamics. As a natural flying machine, each bird is built for great power and lift, the maneuverability required for its lifestyle, light weight, and fuel efficiency. In its overall construction, every detail is in harmony with its individual flight pattern, its habitat, and its behavior.

BIRD BENEFITS AND DETRIMENTS

The Good Side

Since you are reading this book, chances are you already are interested in birds and have some good feelings about them. You probably do not need to be convinced that birds deserve a place in man's environment. Perhaps you agree with Emerson, as we do, that "Beauty is its own excuse for being." But birds also provide more tangible benefits for the citizens of the commonwealth.

Sport Hunting

Fewer than 10 percent of Pennsylvania's bird species are classified as game, but each fall they attract hundreds of thousands of sportsmen, eager to test their skill against some of nature's wariest creatures. The rewards are many: the crisp autumn days spent in the field, the companionship of fellow sportsmen, the devoted cooperation of a well-trained dog, the thrill of a successful hunt, and a table laden with tender roast pheasant or grouse in wine sauce. As our most popular game birds, ring-necked pheasants and mourning doves rank first in the autumn harvest with about one million of each species taken per year in Pennsylvania. In 1980, about half a million ruffed grouse found their way to the hunter's table, along with a quarter-million woodcock, the same number of ducks, about 50 thousand turkeys, 60 thousand geese, and 40 thousand quail.

With moneys earned through the sale of over a million hunting licenses a year, the Pennsylvania Game Commis-

Game birds such as grouse, ring-necked pheasants and turkeys are pursued by hundreds of thousands of Keystone State hunters every year.

sion carries out management and research programs that benefit game and nongame wildlife alike. The Commission manages over 1¼ million acres of State Game Lands which are open in season to public hunting and provide some of the best birdwatching in the state. It regulates the take of our resident game species to insure a perpetual supply of harvestable wildlife. It works closely with state foresters and private landowners to maintain and improve bird habitats throughout Pennsylvania. And it publishes literature, such as this book, to inform the public about Pennsylvania's wildlife heritage.

Birdwatching

Unlike hunting, birdwatching is a year-round sport that can be enjoyed by city dwellers and rural residents alike. In fact, there are few more satisfying places to observe birds than in a well-landscaped suburban backyard, which may host as many as 50 to 100 bird species a year.

Although most Pennsylvanians have passed a few pleasant minutes or hours observing birds at one time or another, relatively few could be called committed birdwatchers. For many people, it is not even necessary to know what kind of bird is being watched; they spy on each species in equal and unbiased fascination. But for others, birdwatching becomes a disease, a mania, a benign compulsion of astounding proportions. Its symptoms include a permanent indentation behind the neck in the shape of a binocular strap, a curious upward tilt to the gaze which causes frequent stumbling on uneven terrain, a quick-draw reflex toward the bird book whenever memory fails, a willingness to drive hundreds of miles to view a chuck-will's-widow outside its normal range, a preference for vacations in such birding hot-spots as Florida or Arizona, and a "life list" recording confirmed sightings of over 500 different bird species.

One extension of the birdwatching compulsion that requires even more patience but produces a more tangible reward is bird photography. The best time to hunt birds with a camera is during the breeding season, when their plumage is most distinctive and their activities are localized around the nest. The winter feeding station is another place where the amateur photographer is more likely to capture his elusive subjects on film. But even when you know where the birds are, it often takes hours of sitting quietly in the shrubbery or in a blind for a single good photograph. The photographer also has a responsibility not to jeopardize his subjects, always remembering that birds and their nests are protected by law. Birds are most firmly attached to their nests and are most likely to tolerate disturbance when they are caring for young. On the other hand, a nest disturbed during construction or incubation is likely to be abandoned. Despite the difficulties of this demanding hobby, there are few more effective ways to observe nature than to sit quietly in its midst, and the wildlife photographer often sees things that elude the less patient observer. Anyone who is interested in bird photography will want to read about Eliot Porter's fascinating experiences in his beautifully illustrated book, *Birds of North America, A Personal Selection.*

Birds as Indicators of Environmental Health

Perhaps one of the most important roles that birds play in this highly technological world is to indicate when technology may be running amok, before it is too late to save humanity from itself. Like the canary in the coal mine, birds can provide early warning of environmental dangers that are not yet detectable by man.

The widespread contamination of the environment by DDT is a case in point. DDT went into use for insect control shortly after World War II, and it did its job well. The pesticide can be credited with increasing agricultural yields and reducing the incidence of insect-borne diseases in many parts of the world. But DDT is a persistent pesticide. It doesn't break down after it has done its job, and so it remains in the environment essentially unchanged for many years. The first warning that DDT was building up to dangerous levels in ecosystems came from ornithologists, who witnessed widespread reproductive failures in falcons, ospreys, pelicans, and other predatory birds. At the tops of their food chains, these carnivores accumulated in their bodies all the DDT contained in the hundreds of lightly contaminated prey they consumed over time. Eventually their pesticide burdens became so great that they could no longer reproduce normally. One particularly bizarre symptom of DDT contamination is the production of eggs with abnormally thin shells, causing them to break under the weight of the incubating parent. Before the problem was recognized and corrected, DDT poisoning caused the extinction of the entire eastern population of peregrine falcons and the near extinction of the fish-eating osprey. Today, the osprey is making a comeback, and the majestic peregrine is being reintroduced into Pennsylvania and other states. Thanks to the birds that sounded the alarm, a DDT-caused disaster may have been averted. Still, people can not afford to be complacent about the worldwide use of hundreds of different chemical pesticides. Like the falcons, man is also at the top of his food chain, and will be among the first creatures on earth to suffer the effects of pesticide abuse.

Through their numbers and variety, birds also reflect the quality of environments inhabited by man in a much more subtle way. Birds live in any area where the habitat meets their needs for food, cover, and nesting sites. When a species vanishes from a locale where it had lived in the past, this often means that the habitat has changed in some way, making it impossible for the bird to exist there any longer. Because many birds are very sensitive to small changes in their habitats, biologists and land managers use them as "indicator species" to warn of habitat deterioration before it has gone too far to reverse.

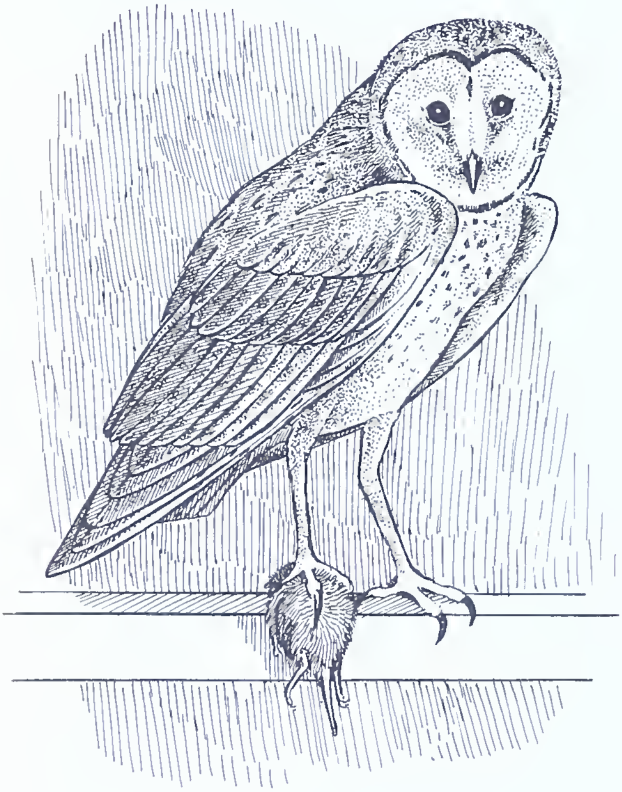
Birds as Consumers of Pests

The untold millions of birds in Pennsylvania consume massive quantities of food each year. While most of these food items are of no consequence to man, many are significant pests to farmers, foresters, recreationists, and homeowners. By destroying noxious insects, rodents, and weed seeds, birds serve the economic interests of the commonwealth.

Songbirds, especially during the breeding season, are voracious consumers of insects, many of which are serious agricultural pests. Grasshoppers make up as much as 22 percent of the bluebird's diet and 26 percent of the meadowlark's. In one study, the stomachs of crows were found bulging with more than 1,000 grasshoppers each, and individual starlings and grackles held more than 1,500 of the young insects. Grain-destroying chinch bugs are eaten by 39 different bird species, with bobwhite, meadowlarks, and thrashers often eating more than 100 at a time. A single warbler can eat up to 3,500 aphids per hour. Cutworms are taken in quantity by bobwhite quail, killdeer, cuckoos, catbirds, and others. And black-billed and yellow-billed cuckoos are major destroyers of hairy caterpillars, such as tent caterpillars and the forest-defoliating larvae of the gypsy moth.

Several historical records suggest that large numbers of voracious birds can turn the tide of an insect plague and save crops or forests from extensive damage. But the primary role of birds in insect control seems to be in delaying or preventing major outbreaks by holding insect numbers down. When an insect population is able to increase rapidly to plague levels, overwhelming even the most efficient predators, there is little that bird populations can do to reverse the epidemic.

Rodents are another class of agricultural pests that destroy crops, ravage corn cribs, foul stored grain, and pilfer livestock feed. While they have many enemies around the farm, ranging from pouncing cats to gliding snakes, there are few more effective predators than the hawks that harass them by day and the owls that swoop down on them by night. It was once thought that predatory birds were the farmer's enemies, and the "chicken hawk" idea is slow to die. But it is now known that hawks and owls do farmers far more good than harm. Most of the larger hawks are almost exclusively rodent eaters, while the smaller accipiter hawks take mostly small birds. It is a rare individual that earns the title of "chicken hawk." In one early study of the contents of 220 stomachs of red-shouldered hawks, only three contained poultry. Today, most people have come to appreciate the beneficial role played by these magnificient birds, and all birds of prey have been given the complete protection of the law.



Weed seeds are a staple in the diets of many birds, particularly the finches and sparrows, whose beaks are specially adapted to crack the toughest seed coats. Weed seeds make up about 75 percent of the song sparrow's year-round food intake and 89 percent of the American goldfinch's diet. Among the other groups of birds, bobwhite quail devote about half their diet to seeds, and a total of 23,000 weed seeds was once found in the stomachs of three plump mourning doves.

Birds as Scavengers

By feeding on dead animals or garbage, scavengers are the sanitation workers of the bird world. Often seen patrolling our highways, looking for any unfortunate creatures that failed to dodge the traffic, the turkey vulture is one of nature's best-known morticians. In recent years, the smaller black vulture has expanded its range northward into Pennsylvania and now is seen frequently soaring on the thermals alongside its larger relative. Crows and ravens also seek out the easy meals along Pennsylvania's roadsides, often showing little fear of passing traffic. Scavenging gulls are partial to garbage dumps, where they may gather by the hundreds to feast on the smorgasbord laid out by the continuously arriving trucks. Some of our smallest scavengers include the starlings that pace the shoulders of roads looking for stunned or dead insects that ricocheted off passing automobiles, and the house sparrows that pick fresh bugs off the grillwork of parked cars.

Lucky is the farmer who has a barn owl or two prowling around his property. Hawks and owls provide a great service by keeping small mammal populations in check.

The Bad Side

Bird problems exist whenever the interests and activities of man and birds come into conflict. Birds do not set out to do deliberate harm. Like all animals, they must gather food, escape their enemies, and raise their young if they and their species are to survive. But when the food they gather is also coveted by a farmer, or the place they choose to roost is directly above your picnic table, then they become a problem. Bird conflicts can be of several types. Birds may cause economic loss by stealing food or damaging manmade objects. They may affect human health by spreading disease or causing accidents. Or they may create nuisance problems that are not severe but are nonetheless annoying.

There are no such things as "good species" and "bad species" among birds. Any species can be desirable in one setting and undesirable in another. The mallard is a prized bird among sportsmen and nature lovers, but it can cause severe economic loss by feeding in grain and sorghum fields. Meadowlarks eat insects that destroy farm crops and brighten any summer day with their enthusiastic singing, but at times they do damage to sprouting corn. The cheerful robin, loved by suburban homeowners as the harbinger of spring, is a notorious pest in Pennsylvania's cherry orchards and vineyards.

Birds as Agricultural Pests

Each year Pennsylvania farmers lose millions of dollars worth of grain, produce, and livestock feed to a variety of different birds. Of course, birds also help farmers by destroying insect pests, but unfortunately it is not known to what extent the benefits and losses caused by birds cancel each other out.

Field corn for grain and silage is Pennsylvania's most important crop, so it is not surprising that damage to corn is a large portion of the bird-caused economic loss to agricultural interests in the state. In 1979, red-winged blackbirds and common grackles consumed an average of one-half bushel of corn per acre, for a total statewide loss of corn worth $1.4 million. Although

Red-winged blackbirds and grackles consume over a million dollars' worth of ripening field corn annually in the state, but the loss is generally so widespread that it is insignificant to individual growers.

this may sound like a great deal of money, it is less than one percent of the state's total corn crop. Furthermore, the losses of corn resulting from harvesting, transportation, and storage may be more than ten times as great.

Bird damage to corn is an important problem only because it is so spotty in its distribution. While most farmers suffer very little damage, some may lose as much as 17 bushels of corn per acre. Often these hard-hit farms are located near traditional roosting sites for blackbird flocks. Individual farmers can reduce their losses in local areas by using acetylene or propane "exploders." These cannon-like devices automatically make loud, exploding noises at intervals to frighten away the birds over about a 10-acre area. Another technique is to use an appropriate insecticide on the crop sometime before the milk stage, at which time the corn becomes vulnerable to birds. Many birds are attracted to the field initially by the insects it contains, and only later attack the corn.

The American robin is the favorite bird of many Pennsylvanians, but not of the fruit grower. The colorful and vociferous robin is one of the most destructive avian pests of commercial cherry orchards and vineyards. Along with common grackles and starlings, they do about $1 million worth of damage to fruit in the commonwealth each year. Birds can be discouraged from attacking sweet and tart cherries by applying a chemical repellent that makes a bird sick after it eats a treated cherry. Although some fruit is still damaged, the birds eventually go away when they learn that the fruit is tainted. Similar repellents have been approved for use on few other fruit crops, so the bird-control options are few. One method that is useful on very high-value crops, such as table grapes, or on small backyard vineyards and strawberry patches, is netting. Lightweight nets are placed over vines or other plants and keep most birds out.

Livestock feedlots and poultry operations are places where the introduced European starling gathers to pilfer the animals' feed and, in so doing, contaminates the food with its droppings. In addition, the mere presence of large numbers of starlings disturbs cattle so much that they gain weight more slowly than undisturbed animals. In a business in which weight is profit, slower growth means lower earnings for feedlot operators. While robins and native blackbirds are protected by law and can not be killed without official permits, starlings are not. The most effective way to control starlings at feedlots is by providing a government-approved poisoned bait that is kept separate from the livestock feed. Physical barriers are also effective against starlings. Heavy flaps in front of feeding troughs can be pushed aside by hungry livestock but deter starlings, and smaller poultry or livestock operations can be completely screened over for an economical solution to the problem.

If you suspect that you have a problem with bird damage to crops, orchards, feedlots, or other agricultural

Almost all bird-related problems are a result of the large, often overwhelming flocks that form after the nesting season is over. Fortunately these flocks are transient and the problems they cause are normally only temporary.

enterprises, the person to get help from is your county agricultural extension agent. He can diagnose the cause of your problem and recommend treatment. Your extension agent also has the latest information on approved chemical repellents and toxicants, as well as instructions for their safe use.

Problems with Roosts

In summer and fall, after they have finished their solitary nesting and have fledged their young, common grackles, red-winged blackbirds, and starlings band together into increasingly larger and larger flocks which fan out over the landscape to forage by day and coalesce each night into compact roosts. These summertime roosts range in size from a few thousand to over a hundred thousand birds. As winter approaches, these minor roosts break up as some birds migrate south of Pennsylvania's borders, while others come together into a few mammoth assemblages in our southeastern counties. For many years, York County has played host to a winter roost containing about 10 million grackles, starlings, blackbirds, and cowbirds, often with a handful of robins for good measure.

Besides the problems they may cause in their daytime feeding trips, roosting birds sometimes come into conflict with humans when they choose undesirable roost sites. Roosts are commonly formed in densely foliated clumps of trees, such as unthinned woodlots and isolated conifer plantations. Problems arise when birds choose to congregate in city parks, state recreation areas, trees adjacent to municipal drinking-water reservoirs, and rows of planted residential street trees. The ground beneath any roost quickly becomes fouled, and our largest winter roosts may accumulate several inches of droppings beneath them in a single winter.

Objectionable roosts can often be moved by using a combination of scare tactics as the birds assemble in the evening — whistle bombs and shell crackers, tape recordings of the birds' own distress calls, and fountains of water from municipal fire hoses. But scaring birds is, at best, a temporary remedy. They often return the following night. A more permanent solution is to alter the roost site so that the birds no longer find it suitable. Roost sites are chosen for their thick foliage that provides innumerable perches and good protection from the elements. A woodlot site can be made unusable as a roost by extensive thinning, perhaps by removing every second or third tree. Valuable street and yard trees need not be cut down. Instead, they should be heavily pruned, reducing the density of their foliage by about half.

Birds and Disease

Birds are rarely a direct health hazard to humans, because few avian diseases are infectious to man. But birds may affect human welfare indirectly by aiding and abetting the spread of diseases to man and his domestic animals. One example is histoplasmosis, a respiratory disease caused by inhaling the spores of the *Histoplasma* fungus that lives in the soil. The fungus grows well in soils that are heavily fertilized with bird droppings, such as under blackbird or pigeon roosts, and in poultry yards. Histoplasmosis is not a contagious disease and is rarely fatal, but may cause cold-like respiratory discomfort.

Wild birds also harbor several strains of encephalitis virus — eastern, western, and St. Louis — that are transmitted harmlessly from bird to bird by blood-sucking mosquitoes. Certain introduced bird species, such as pheasants and house sparrows, have been fatally stricken with the virus, but native species seem to be immune. The occasional cases of encephalitis in humans occur when susceptible persons are bitten by infected mosquitoes. The disease affects horses as well as humans, and can result in high fever, convulsions, and even death.

Outbreaks of the disease are best controlled by reducing the populations of mosquitoes that serve as vectors, rather than by eliminating large numbers of birds.

Collisions with Aircraft

The dangers of bird collisions with aircraft first came to the public's attention in 1960, when a Lockheed Electra tangled with a flock of starlings and crashed into Boston harbor shortly after takeoff, killing 62 of its passengers. Birds and aircraft have competed for airspace ever since the Wright brothers' first powered flight, but the hazards have intensified recently with higher aircraft speeds and the switch from piston to turbine engines. With older, propeller-driven planes, only the largest birds posed any real danger, and the damage was usually to the airframe rather than to the hardy piston engines. But with today's modern jet aircraft, even the smallest songbird, when ingested by a high-speed turbine engine, poses a serious threat to human life.

The greatest danger from bird/aircraft collisions occurs at airports, where birds are more abundant than at high altitude, and where airplanes have the greatest need for power and maneuverability. Unfortunately, the areas around airports are sometimes very attractive to gulls, starlings, and other birds because of nearby garbage dumps or wetlands, or because open areas adjacent to the runways provide good feeding or loafing sites.

To lessen the bird hazard at airports, air-traffic controllers often use special radar to monitor bird flocks and warn pilots. Nearby garbage dumps are often closed and the remaining garbage buried or removed. Areas around runways are made less attractive for foraging by using pesticides that kill earthworms, insects, and rodents. In addition, major airports sometimes have patrol vehicles that disperse hazardous bird flocks by broadcasting tape-recorded distress calls.

Damage to Man-made Structures

Sometimes birds do damage by building their nests in inappropriate places. Along the New England coast, it was once common for ospreys to take over offshore bell buoys, and some ospreys building nests on power poles have shorted them out by dropping wet seaweed across the wires. In Pennsylvania, the house sparrow can be a major nuisance, constructing its bulky nests under the eaves of houses, in louvered attic vents, inside drainpipes, and on commerical signs and buildings.

In many cities, bird droppings deface buildings and foul sidewalks, particularly in older sections where the ornate architecture of the past provides abundant ledges and crevices for perches and nests. The primary species involved are the introduced starling, house sparrow, and common pigeon, causing many a city dweller to curse the shortsighted importers who brought these pests to the New World. Besides being esthetically unappealing, bird droppings corrode limestone statues and building stone, and carry diseases that can be infectious to man.

ATTRACTING BIRDS TO YOUR LAND

Managing for Birds

To many people, the words "wildlife management" bring to mind the efforts of state and federal biologists who cultivate food plots, establish escape cover, create forest openings, manipulate wetland water levels, establish open seasons, and regulate the harvests of our major game animals. Although these activities are critical to the well-being of our game populations, there is much more to wildlife management than just game management.

Wildlife management includes any actions that are *deliberately* taken to change the abundance or distribution of a wildlife population. The word "deliberately" is emphasized because many of man's activities — clearing of forests, draining of wetlands, construction of housing tracts — have profound effects on wildlife populations. But unless they were carried out with definite wildlife goals in mind, such activities are not wildlife management.

It is a common misconception that wildlife management is something done only by employees of our state and federal wildlife agencies on public lands. But in a state such as Pennsylvania, in which 87 percent of the land is privately owned, private citizens have a far greater influence on the wildlife resources than do all the professional wildlife managers combined.

Of all the different kinds of wildlife in Pennsylvania, birds offer the greatest opportunity for public involvement in wildlife management. Birds are found in every major environment in the state, from the most highly developed urban area to the deepest forest. The great variety of birds and their relative conspicuousness in the environment make them easy to find and fascinating to watch. Most birds are migratory, so different assemblages of species greet the landowner as the seasons change. And because most birds are highly mobile and have relatively high reproductive rates, they respond quickly to management efforts.

Bird Management is Primarily Vegetation Management

The first step in managing any piece of land to benefit birds is to identify the resources that birds need, but which may be in short supply. As do all animals, wild birds need adequate food and water supplies, shelter from the weather and from predators, and suitable breeding sites. Most of these needs are provided by vegetation that is suitably distributed in the environment. Vegetation provides food in the form of seeds and fruits, and by supporting many kinds of insects on their leaves, branches, and stems. Thick shrubs and trees provide shelter from storms and escape cover from enemies. And most birds build their nests in trees or shrubs, or on the ground immediately adjacent to plant cover.

In managing for birds, people usually want to attract the greatest possible number of different species. If that is your goal, it is important to remember that each bird species has its own particular habitat requirements. For example, redstarts glean insects from the leaves and twigs of trees, and nest well above the ground. Catbirds prefer abundant shrubs where they find insects and fruits, and build their ragged nests. Rufous-sided towhees scratch noisily through the leaf litter beneath trees and shrubs in search of insects, and usually nest on the ground. Acadian flycatchers snatch flying insects out of the air, and suspend their hammock-like nests between the forked twigs of trees. The way to attract the greatest variety of birds is to provide the greatest possible diversity of habitats for different species to exploit.

Bird Habitats are Layered

The best environments for songbirds have abundant plant foliage in clumps and patches both near the ground and overhead. It is often useful to visualize bird habitat as consisting of three idealized layers of vegetation. The lowest layer, or understory, extends from the ground surface to a height of about 3 feet, and should contain scattered clumps of shrubbery interspersed with areas of broadleaf herbaceous plants, lawn, or bare earth. The midlayer, extending from 3 feet to 20 feet above the ground, contains the leafy foliage of scattered large shrubs and small trees. The topmost layer, above 20 feet, holds the canopies of the largest trees separated by sufficient space to allow plenty of sunlight to reach the ground.

Each layer of the habitat offers foraging and nesting opportunities for many kinds of birds. If any layer of foliage is sparse or missing, then the characteristic set of bird species adapted to that layer will be absent, too. Even a relatively small property, like a suburban residential lot, can attract an amazing variety of birds if it contains an adequate mixture of trees, large shrubs, lawn, bare ground, and low herbaceous plants. The following sections give more specific suggestions on ways to benefit birds in urban and suburban areas, in forests and woodlots, and on the farm.

A Backyard Full of Birds

One of the greatest pleasures of home ownership is that it provides a haven in which to escape the demands

Optimum habitat for the greatest variety of birds consists of three layers: the understory, which includes bare ground and plants up to three feet in height; a midstory layer composed of shrubs up to 20 feet in height; and the canopy layer, made up of scattered mature trees.

of the outside world. For a while, at least, you can forget about the job, the school, the crowds at the supermarket, and the bustle downtown, and retreat to the relative serenity of your own property. And nothing adds to that serenity more than a backyard that is attractively landscaped and alive with wild birds.

Most homeowners in urban and suburban areas already plant trees, shrubs, lawns, and flowering plants to beautify their properties and increase the value of their homes. And while any landscaping at all is better for birds than none, a little additional planning can turn an ordinary backyard into a bird garden.

Wild birds need three things in proximity: food, cover, and water. All of their needs can be provided through landscaping that is both attractive and functional. There is no need to sacrifice other uses of your yard in order to attract birds.

Birds Need Varied Landscaping

As in other environments, the greatest variety of birds occurs in backyards that contain a variety of plants of different sizes and shapes. Dense clumps of shrubbery should be interspersed among trees, lawn, and garden. Plantings should be arranged in ways that produce the greatest amount of edge between vegetation of different heights and thicknesses. Large shrubs are particularly important and are most often sparse or lacking in suburban yards. Mature shrubs provide perches, feeding sites, protection from the weather and from predators, and nest support for a variety of birds.

A backyard landscape should be planned with viewing in mind. Consider the height a plant will attain at maturity, and place taller trees and shrubs in the rear. Tall vegetation should form a backdrop which encloses your property, while displaying birds for easy observation from your back porch or windows. Place clumps of shrubbery carefully, so as not to block your view of any interesting corner of your backyard habitat. Plant open areas in lawn to attract foraging robins and grackles. And be sure to leave room for beds or borders of flowering annuals, such as salvia, impatiens, and petunias. They not only brighten the backyard scene, they also attract hummingbirds and seed eaters.

Invite Birds to Your Backyard

1. Choose plants that will attain a variety of sizes and shapes at maturity — from tall trees, through large and small shrubs, to low ground cover, flower gardens, and lawn.
2. In particular, plant abundant shrubs in clumps and along borders, but leave enough open space so you can observe birds easily. Maximize the amount of "edge" between plantings of different heights and thicknesses.
3. Consider the mature height of your plantings, and place taller plants behind shorter ones.
4. Plant a mixture of deciduous and evergreen species.
5. Emphasize fruit-producing shrubs and trees, and choose species with different fruiting times to make food available throughout fall and winter.
6. Use feeders to supplement winter food supplies and entice birds into the open. Continue feeding well into spring, when natural foods become available.
7. Include a bird bath or a small pond in your landscaping. It will be a center of bird activity in your yard.
8. Provide nest boxes for cavity-nesting birds. Natural cavities are few in residential areas.
9. Minimize your use of insecticides. Not only are insects important bird foods, but also some insecticides are very toxic to birds.

Evergreens for Shelter

Birds are present in your yard the year around, so your landscaping must meet their needs in winter as well as in summer. A critical need is shelter from winter weather. This need is filled by evergreen shrubs and trees that provide cover after deciduous species have lost their leaves. In Pennsylvania, some of the more popular evergreen landscape plants include rhododendron, hemlock, spruce, pines, holly, red cedar, and yew. Spruce, red cedar, and yew also make excellent nesting cover during the breeding season. The accompanying table can help you select plants for your yard.

Plant Fruit-producing Shrubs and Trees

When choosing deciduous trees and shrubs, pick species that produce berries and fruits, particularly during fall and winter. Mockingbirds, cedar waxwings, thrushes, catbirds, robins, and many other species consume large quantities of fruits during late summer and fall. Plants that set fruit late in fall, or whose fruits persist on the branches throughout the winter, are particularly valuable to those birds who make their winter homes in Pennsylvania.

To be sure that fruits are available to birds throughout the late summer, fall, and winter, you should plant several kinds of shrubs that bear fruit at different times. Choose species whose fruiting times overlap so that food will be available continuously. A backyard planted in red mulberry, flowering crab apple, mountain-ash, red cedar, tatarian honeysuckle, American cranberrybush, and bayberry would provide a year-round feast for fruit-loving birds.

Put Up a Feeder

Bird feeding is a particularly satisfying hobby for the backyard bird enthusiast. A feeder draws birds into the open and nearer to the house, where they can be observed easily. Few birds, however, will stray far from protective cover, even to enjoy a free meal. Feeders should be placed close enough to shrubby growth to afford some protection, but not so close that hungry cats can use the shrubs for camouflage. Much of the activity at a feeder takes place on the ground beneath it, where many birds clean up dropped food. This area should be free of dense vegetation that might hide predators.

Shrubs and trees near your feeder also provide perches for birds awaiting their turn to feed. If you must put your feeder in the open, a few large tree branches stuck in the ground to simulate shrubbery can furnish needed perching sites.

During the winter months, bird feeders are valuable supplements to naturally occurring food supplies. Because of the easy availability of food put out by humans, some birds, such as goldfinches, now spend the winter much farther north than they did before the widespread use of feeders.

Once you start feeding birds in late fall, you should not stop feeding until mid-spring, when natural foods again become plentiful. The birds attracted to your feeder soon become dependent upon it for much of their winter food. The presence of a feeder keeps bird populations artificially high—higher than natural food supplies can support. If the feeder is not filled regularly, some birds may die. Birds get the fuel they need to keep warm from the food they eat; an underfed bird could die of exposure. The continuous availability of food is less critical if there are other active feeding stations in your immediate neighborhood.

Provide a Place to Bathe

For most people, a bird bath is the summer substitute for a feeder, and its effect is much the same. A bath, or a shallow pond incorporated into your landscaping, will attract birds from a wide area. A strategically located bath lures birds into the open where they are

SOME VALUABLE LANDSCAPE PLANTS FOR ATTRACTING BIRDS TO YOUR BACKYARD

Trees	**Evergreen (E) or Deciduous (D)**	**Cover**	**Food**	**Timing**
Black and Wild Red Cherry	D		X	(Aug-Oct)
Common Chokecherry	D		X	(July-Sept)
Flowering Crabapple	D	X	X	(Aug, persistent)
Flowering Dogwood	D		X	(Sept-Oct)
Washington Hawthorn	D	X	X	(Sept-Oct, persistent)
Eastern Hemlock	E	X		
American Holly	E	X	X	(Nov, persistent)
American Mountain-ash	D		X	(Oct)
Red and White Mulberry	D	X	X	(June-Aug)
Austrian, Norway, and white pine	E	X		
Eastern Redcedar	E	X	X	(Sept-May)
Serviceberry	D		X	(June-Aug)
White and Norway Spruce	E	X		
Shrubs				
Arrowwood (Viburnum)	D	X	X	(July-Sept)
Japanese Barberry	D	X		
Bayberry	D		X	(Sept-April)
Bittersweet	D		X	(Sept-Oct, persistent)
Blackberry	D		X	(July-Aug)
Blackhaw (Viburnum)	D	X	X	(Sept-Oct, persistent)
Common Buckthorn	D	X	X	(Sept-Oct)
American Cranberrybush	D	X	X	(Aug-Sept, persistent)
Alternate-leaved, gray, silky, and red-osier dogwoods	D		X	(Aug-Oct)
American Elder	D	X	X	(Aug-Sept)
Scarlet and European Red Elder	D	X	X	(June-July)
Tatarian Honeysuckle	D	X	X	(June-Aug)
Common Juniper	E	X		
Mountain Laurel	E	X		
European Privet	D	X	X	(Sept, persistent)
Rhododendron	E	X		
Snowberry and Coralberry	D		X	(Sept-Oct)
Spicebush	D		X	(Sept)
Mapleleaf Viburnum	D		X	(Sept)
Common Winterberry	D		X	(Nov-Jan)
Canada Yew	E	X		

easily seen, and can provide hours of watching pleasure on a hot day. As with feeders, bird baths should be located within easy reach of protective cover. For the truly committed bird enthusiast, small electric heaters are available to keep your bath ice-free all winter.

Nest Boxes Provide Homes

As the shrubs and trees in your yard mature, they will provide nesting places for robins, catbirds, finches, doves, and many other open-nesting songbirds. But the cavity-nesting birds need special consideration. In residential neighborhoods, it is seldom practical to leave standing the decaying trees that provide homes for cavity nesters in the wild. Dead trees are considered unsightly in urban areas, and they also can do considerable damage when they fall.

Nest boxes are the best way to encourage breeding by cavity-nesting species in the suburbs. One of the most delightful cavity nesters in residential areas is the house wren, whose bubbling exuberant song can be heard throughout the neighborhood. Other birds that will readily use nest boxes in appropriate habitat include kestrels, screech owls, bluebirds, house finches, purple martins, house sparrows, and starlings.

House wrens readily occupy nest boxes placed in suburban yards anywhere in the state, and their warbling song will certainly brighten the environs of your home.
Leonard Lee Rue

Go Easy with Insecticides

Nearly all birds eat insects at some time in their lives. Warblers, flycatchers, woodpeckers, wrens, and swallows are almost totally insectivorous. But even seed-eating birds, like sparrows and finches, depend upon plentiful insects to nourish their young. One reason that highly varied landscaping supports more birds is that it also supports more abundant and varied insect life.

Because of their effect on food supplies, careless use of insecticides can reduce the attractiveness of your yard to birds. If you want to live with birds, you should be prepared to accept some insects. Of course, many insects are beneficial because they pollinate plants or prey on more injurious pests.

If you must use an insecticide, spray only those individual plants that are being damaged. Never broadcast pesticides throughout your yard. Whenever possible, use a biological insecticide, such as *Bacillus thuringiensis,* and avoid spraying when birds are nesting. Use great care with any pesticide whose label says it is toxic to wildlife.

Improving Forested Lands for Birds

Forests and woodlands can be improved for songbirds by creating the greatest possible interfingering of habitats for different species to occupy. At the same time, the landowner can increase his or her enjoyment of the managed woodland by establishing a trail that passes near the choicest birdwatching spots.

Many Pennsylvania woodlands are too mature to be good songbird habitat. The intermingling tree canopies in a mature forest block out sunlight and prevent much growth of shrubs or herbaceous plants on the forest floor. Mature forests often lack those bird species that need the nesting sites, singing perches, fleshy fruits, and escape cover that low, shrubby vegetation provides.

Break Up Continuous Forest

The first step in managing a mature forest stand for birds is to open up the canopy so that more sunlight strikes the ground, encouraging understory vegetation. This can be accomplished by selectively removing every third or fourth tree, so that no more than 75 percent of the sky is obscured by tree crowns. In felling trees, be careful not to damage any shrubby growth or saplings that may already be present. Tree cutting should be done in fall or winter to minimize disturbance to nesting birds. This is a good time to build up next year's firewood supply.

If the forested area is larger than about 10 acres, one or more clearings should be created within it. A single clearing should be at least one-half acre in size, and should have irregular margins to look as natural as possible. Clearings not only encourage herbaceous plants and shrubby growth; they also create edges — the boundaries between different habitat types. Edges can be particularly rich in birdlife because they are areas of overlap between the bird communities living in each adjacent habitat. Edges may also attract some bird species that require both habitats within easy reach and cannot live in either habitat alone. In spring and summer, bird nests are often concentrated along habitat edges.

Snags for Cavity Nesters

Several kinds of forest birds nest in cavities within the trunks and limbs of standing dead trees (snags). Some species, called primary cavity nesters, excavate their own holes. Woodpeckers and chickadees are common primary cavity nesters in Pennsylvania. Secondary cavity nesters, such as great crested flycatchers and tufted titmice, use naturally occurring cavities, or holes that have been abandoned by other species. Different bird species require different size cavities, but in general, the larger the snag the more opportunities there are for use by cavity-nesting birds.

Five or more snags per acre is about optimum for cavity-nesting birds in Pennsylvania's hardwood forests. Snags can be created where none now exist by girdling appropriate trees.

IMPROVING FORESTED LANDS FOR BIRDS

1. Open the dense canopy in mature forests by removing or girdling every third or fourth large tree.
2. Increase habitat 'edge' by creating small, irregular clearings in large forest stands.
3. In forests managed for timber production, harvest trees in small, irregular patches. Preserve beech, dogwood, and cherry for wildlife food.
4. Leave five or more large dead trees (snags) per acre in locations where they are not hazardous.
5. Provide nesting boxes if few dead snags are available.
6. Encourage fruit-bearing shrubs and vines.
7. Encourage evergreen shrubs and trees for winter shelter.
8. Encourage shrubby growth near streams and in other wet areas.
9. Establish a birdwatching trail through your managed woodland.

Girdling means the removal of both the outer and inner bark in a strip completely around the base of a live tree. Girdled trees die quickly and soon start to decay. Cavity-making birds generally excavate their holes in the softer wood of partly decayed snags. A good time to create snags is when you first open up the forest canopy. Rather than felling all the trees you want removed, girdle some and leave them standing. Be sure to leave snags only in places where they will cause no damage when they eventually fall. In forests with few dead trees, nest boxes can provide homes for cavity-nesting songbirds until a sufficient number of snags can be created.

Producing Timber and Birds

If timber production is a primary goal in managing your woodlands, it may be appropriate to harvest trees in

CAVITY-NESTING BIRDS IN PENNSYLVANIA

Species	Excavates Own Cavities	Uses Natural or Abandoned Cavities
Wood Duck		X
Hooded Merganser		X
Turkey Vulture		X
American Kestrel		X
Barn Owl		X
Screech Owl		X
Barred Owl		X
Saw-whet Owl		X
Northern Flicker	X	
Pileated Woodpecker	X	
Red-bellied Woodpecker	X	
Red-headed Woodpecker	X	
Yellow-bellied Sapsucker	X	
Hairy Woodpecker	X	
Downy Woodpecker	X	
Great Crested Flycatcher		X
Tree Swallow		X
Purple Martin		X
Black-capped Chickadee	X	X
Carolina Chickadee	X	X
Tufted Titmouse		X
White-breasted Nuthatch		X
Red-breasted Nuthatch	X	X
Brown Creeper		X
House Wren		X
Winter Wren		X
Bewick's Wren		X
Carolina Wren		X
Eastern Bluebird		X
Starling		X
Prothonotary Warbler		X
House Sparrow		X

small (one to five acre) irregular patches every few years on a rotating basis. This cutting scheme benefits birds and other wildlife by creating a mosaic of habitat types in different stages of development. Although patches are generally clearcut, certain trees should be preserved for their wildlife value. Beech, dogwood, and cherry provide food for birds and many other kinds of wildlife. Large snags and den trees should be protected from cutting. Also, the cut-over patch will recover more quickly if care is taken during the cutting operation to preserve any shrubs and tree seedlings that may be present on the site.

Encourage Fruiting Shrubs

Fruit-bearing shrubs, vines, and trees are important summer, fall, and winter food sources for many species of forest-dwelling birds. Fruits of dogwood, bittersweet, serviceberry, viburnum, blueberry, huckleberry, Virginia creeper, grape, and even poison ivy are heavily used by birds. Well-known fruit fanciers include the ruffed grouse, wood thrushes, catbirds, brown thrashers, fox sparrows, and rufous-sided towhees, although many other species are attracted to succulent fruits when they are plentiful. One November, a deer-hunting friend of ours stood enthralled for many minutes at the sight of a pileated woodpecker gorging itself on wild grapes.

Evergreens for Winter Cover

Evergreen trees and shrubs are essential in providing shelter for birds during winter, when most other plants have lost their leaves. Good habitat must provide for the needs of birds throughout the year. Although many of our birds migrate south each fall, thereby avoiding winter food shortages and inclement weather, other species are year-round residents of Pennsylvania. Still other species spend the winter here after migrating from more northerly breeding areas. Common year-round residents of Pennsylvania include ruffed grouse and wild turkeys, blue jays, cardinals, chickadees, and woodpeckers. Evening grosbeaks, juncos, and tree sparrows are primarily winter visitors.

Evergreen vegetation provides the best protection from the elements where it occurs in small clumps or thickets, or is planted along woodland borders. Important evergreen trees in Pennsylvania include white, red, pitch, and Virginia pines, red and white spruce, eastern hemlock, balsam fir, and eastern redcedar. Several of these tree species are available as seedlings from the Game Commission's nursery to landowners who wish to improve their properties for wildlife. Evergreen shrubs, such as rhododendron, mountain laurel, American holly, and juniper, should be protected and encouraged.

Wet Areas Attract Birdlife

Although most birds get all the water they need in the food they eat, if open water is available to them, they will be attracted to it. Wet areas also generally support more luxuriant plant growth and abundant insect life. For all these reasons, pond margins, streamsides, and bogs are among the most productive bird habitats in Pennsylvania's forests. These habitats can be protected and improved by encouraging shrubby growth near the water, and by preventing streambank erosion caused by vehicles or livestock. Woodland streams should never be channelized. Channelization destroys any value they might have had as wildlife habitat.

A Foot Path for People

The final step in improving your forested land for birds is to enjoy the fruits of your labors. This can best be done by establishing a foot path through the most productive bird habitats. A walking trail is the best way to bring people and wildlife together,

Great horned owl, by Guy Coheleach. Twenty-five inches long, with a 5-foot wingspan and weighing close to 4 pounds, this is one of the most powerful avian predators on this continent.

Snowy owl, by Mark Anderson. Snowy owls periodically appear here during winters when their prey species reach cyclic lows in the tundra where this owl is normally found.

American kestrel, by George Lavanish. This small falcon is often seen along highways, either perched on wires or hovering over grassy areas in search of prey.

Gyrfalcon, by Ned Smith. Gyrfalcons are rare winter residents in Pennsylvania, but during two consecutive winters in the early 1980s, some ''gyrs'' resided at a quarry in Lancaster County where they fed on rock doves.

Peregrine falcon, by Ned Smith. Before the effects of pesticides reduced this species to near extinction, it was a common raptor along rivers and seacoasts, where it earned the name duck hawk.

Red-tailed hawk, by W. D. Gaither. The distinctive solid red underside of this hawk's tail permits easy identification at long distances.

Goshawk, by Ned Smith. This, the largest accipiter to be found here, is a rare year-round resident of coniferous forests.

Broad-winged hawks, by Ned Smith. This hawk is possibly the most common nesting raptor in the state, and it's also the one most tolerant of man.

G. Lavanish 83

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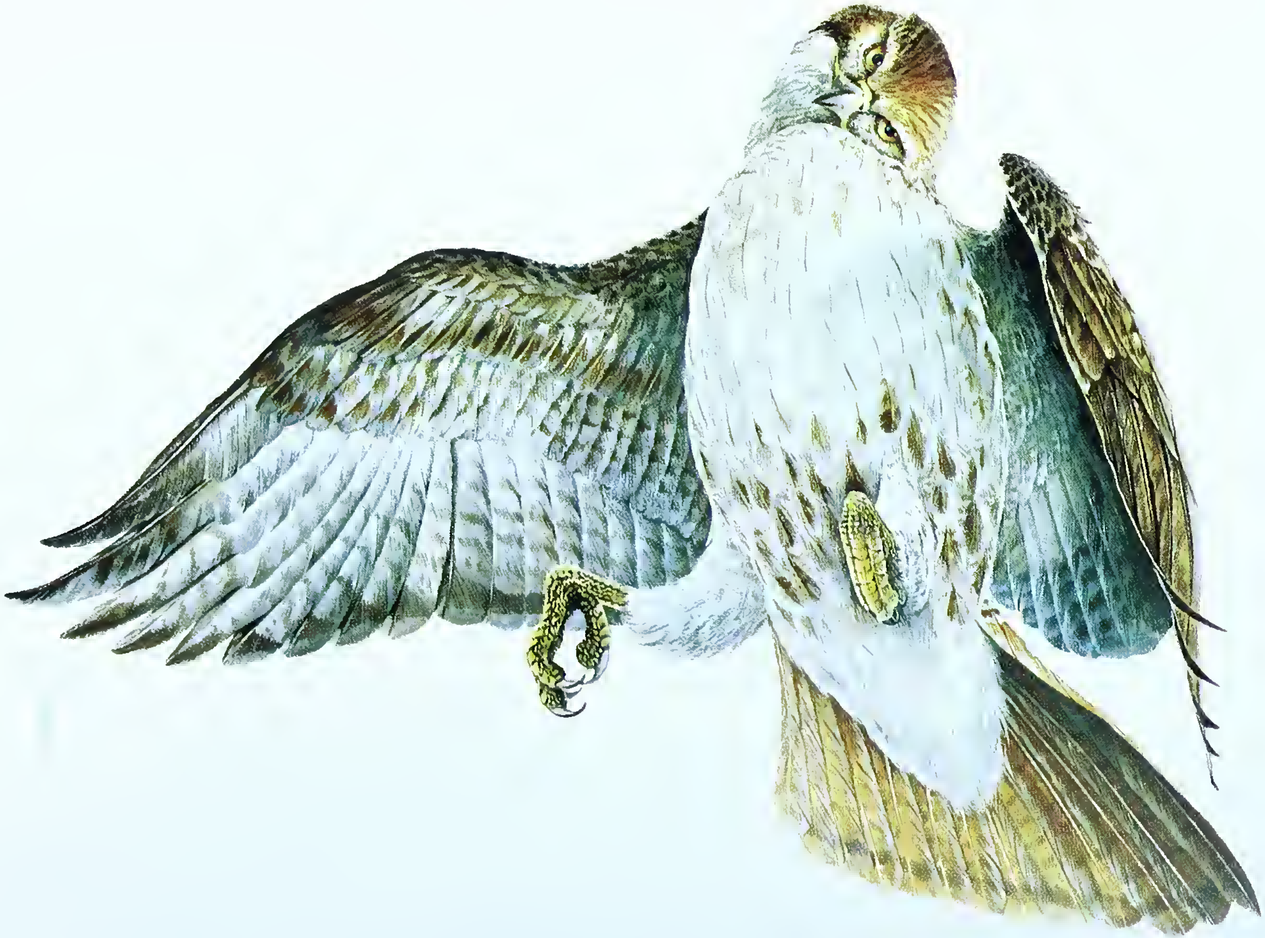

Ned Smith

NED SMITH
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and to view the changes that management of forest habitats has produced. Any trail is more interesting if it winds through the forest and has few long, straight stretches. Keep in mind that you will see more wildlife if they don't see you first. Take advantage of shrubs, tree trunks, and terrain to make yourself less conspicuous as you walk along. A simple foot path need not be elaborately graded or built up, but it should be even enough that you don't spend all your time watching where you step. Occasionally clearing the trail of fallen branches and twigs will help minimize the noise a walker makes. Marking trees with inconspicuous paint spots will help you follow your path even in snow.

More Birds on the Farm

Many factors interact to determine how individual farms develop and how their components are arranged upon the landscape. The characteristics of the terrain and the needs of mechanized equipment generally dictate the sizes and locations of fields and pastures, the presence of woodlots and waste areas, and the locations of roads and buildings. The value of a crop in a particular year may determine what kind of crops are cultivated. On the farm, wildlife production must take second place to food production.

But even with these restrictions, there are many ways that farmlands can be made to attract more abundant and varied birdlife. As in other environments, the keys are diversity in the habitats that different kinds of birds can occupy, and the easy availability of food and water.

Grow Your Own Bird Seed

On the farm, there is little need for bird feeders, except to attract desired species closer to the house. Instead, it

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FRUITING SHRUBS AND VINES OF PENNSYLVANIA'S FORESTS AND FARMS

Species	**Habitat**	**Fruit Availability**
American Bittersweet	Stream banks; abandoned fields; fencerows	Sept-Oct, persisting into winter
Lowbush Blueberry	Dry, rocky, open slopes and ridgetops with acid soils	July-Sept
Brambles (Blackberry, Raspberry, Dewberry)	Abandoned fields and sunny woodland clearings	June-Sept
Chokecherry	Abandoned fields; forest margins; streambanks; roadsides	July-Sept
Pin Cherry	Forest clearings; burns; abandoned fields	July-Aug, persisting until Oct
Sweet Crab Apple	Forest glades; abandoned fields	July-Sept, persisting through winter

Dogwoods	Forest understory and margins; moist areas; abandoned fields	Sept-Oct
American Elder	Moist areas along streams and in bottomlands	July-Sept
Grape	Moist upland forests	Sept-Nov
Common Greenbrier	Abandoned fields; clearings; young forests; primarily on south-facing slopes	Sept-Oct, persisting into winter
Hawthorn	Abandoned pastures; old fields; fencerows	Aug-Oct
American Holly	Moist woodlands	Nov, persisting through winter
Tatarian Honeysuckle	Abandoned fields; fencerows; open woods	July-Aug, persisting into Nov
Huckleberry	Dry, open forests and clearings	July-Sept
Red Mulberry	Moist woodlands	July
Autumn Olive	Woods margins; abandoned fields; hedges and fencerows	Aug-Oct, persisting through winter
Partridgeberry	Wooded areas on soils with high organic content	Aug-Sept, persisting through winter
Poison Ivy	Moist, open forests; streambanks; fencerows	Oct, persisting through winter
Sassafras	Open woods; abandoned fields; forest margins; clearings and burns	Aug-Oct
Serviceberry	Open woods; along streams to dry upland sites	June-Aug
Spicebush	Forest understory; damp woods along streams	Sept-Oct
Sumac	Abandoned fields; fencerows; roadsides; streambanks	Aug-Sept, persisting through winter
Viburnum	Moist to dry upland sites; forest understory and margins; hedgerows; roadsides	July-Oct
Virginia creeper	Moist, open forests; clearings; fencerows; streambanks	Sept-Oct, persisting through winter
Winterberry	Moist, open forests and bogs	Sept-Oct, persisting until winter

is often easier and more effective to cultivate food plots that birds can use during late fall and winter, when other foods are scarce. A food plot may simply consist of a few rows of corn, oats, or other grain, that are left unharvested in the field. Uncut grain should be left only in areas that are within easy reach of thick, shrubby vegetation. Few birds except house sparrows and starlings will venture far from protective cover.

During autumn, abundant food may be available to seed-eating birds in the form of waste grain left on the ground after harvest, as long as fields are left unplowed. But when the first snow falls, loose grain is covered and birds can no longer find it easily. This is when most species will turn their attention to unharvested grain and the seed heads of native grasses still sticking above the snow.

If you have the extra space, an excellent food plot for birds might consist of alternating rows of sunflower, corn, buckwheat, and Japanese or German millet. In the winter, these strips may harbor ring-necked pheasants and possibly a covey of bobwhites, as well as goldfinches, juncos, tree sparrows, and many other interesting songbirds.

Delay Mowing

Several species of birds make their nests on the ground within the sparse cover of low herbaceous vegetation along roadsides or ditchbanks, and in lightly grazed pastures. In cultivated areas, these birds are just as likely to choose hayfields and young grain, particularly when more natural sites are scarce. Pheasants and bobwhites often nest on the edges of fields, not far from a grassy or brushy border. Meadowlarks, killdeer, vesper sparrows, and bobolinks choose fields and pastures. Even some dabbling ducks select upland fields, often at considerable distances from water.

Whenever you have some leeway in the time you mow, choose the latest possible date. This will give ground-nesting birds a little extra time to complete their nesting activities and depart with their young. Many birds nest throughout the summer, making them vulnerable whenever you choose to mow. But most nesting is concentrated in May and June, when even a few days delay in mowing may make the difference between success and failure for many nests.

WAYS TO IMPROVE FARMLANDS FOR BIRDS

1. Leave some unharvested grain in the fields over winter near areas of thick brush. Leave stubble and waste grain unplowed for autumn feeding.
2. If you have space to spare, plant food plots of sunflower, buckwheat, corn, and Japanese or German millet near shrubby cover.
3. Delay mowing of hayfields, roadsides, and ditchbanks as long as possible, to allow birds to finish nesting.
4. Plant a windbreak or shelterbelt on the windward side of farm buildings. Shelterbelts reduce heating costs in winter and create habitat for birds.
5. Cut all trees in a strip at least 20 feet wide along the borders of woodlots and forests. Allow cut-back borders to fill in with shrubs, vines, and herbaceous plants.
6. Plant fruiting shrubs and vines for food, and evergreens for shelter, in hedges, fencerows, roadsides, windbreaks, cut-back borders, and waste areas.
7. Fence all or part of small woodlots to keep livestock out. Thin the woodlot to encourage understory vegetation.
8. Fence at least part of farm ponds and streams to prevent bank trampling by livestock. Encourage shrubby growth near the water.

Plant a Shelterbelt Around the Farmyard

Well-designed windbreaks or shelterbelts around farm buildings can substantially reduce winter heating costs while providing excellent songbird and gamebird habitat. There are also few more effective ways to beautify a farmyard. Shelterbelts are used extensively in the Midwest, where there is little other protection from the wind. There, a shelterbelt may consist of 8 to 10 rows of trees and shrubs. In Pennsylvania, where strong winds are less of a problem, 3 to 5 rows of carefully selected plants should afford ample protection and provide wildlife benefits.

A shelterbelt is planted on the windward side of the farmyard, usually along the north and west. It should be about 100 feet from the yard, so that drifting snow does not accumulate around buildings. The key to a shelterbelt is its shape, with shorter shrubs and trees in the first rows (toward the wind) grading to taller trees at the back. This sloping profile helps lift the wind over farm buildings.

A four-row shelterbelt for Pennsylvania farms might start with tatarian honeysuckle or arrowwood viburnum in row one. Flowering crabapple, chokecherry, or Russian olive might make up row two. Row three should consist of tall deciduous trees, such as box elder, silver maple, green ash, or hybrid poplar. The final row should be tall evergreen trees, chosen from white, red, or Norway spruce, or red pine. Spruces are preferred over pines, however, because their more horizontal branching structure creates much better nesting habitat for birds.

It is best to mix two or more different species in each row. This creates a much more interesting shelterbelt, and increases its value to wildlife.

The rows in a shelterbelt should be planted 15 to 35 feet apart. Spacing between plants within rows should range from about 5 feet for shrubs to 35 feet for tall deciduous trees. More closely spaced plantings may cause drifting snow within the shelterbelt, reducing its value to birds in winter. The wide spacing also allows some herbaceous and shrubby plants to develop in unmowed openings between rows. This increases the nesting and foraging opportunities for birds.

Robins, mourning doves, bobwhites, juncos, goldfinches, and chipping sparrows are a few of the species to expect in a mature shelterbelt. Greater numbers and more species will be present if food plots of unharvested grain, sunflowers, buckwheat, or millet are established nearby. There are generally few snags or dead limbs in young shelterbelts, so nest boxes should be provided for cavity-nesting birds. Boxes designed for wrens and chickadees are not likely to be taken over by the ever-present house sparrows and starlings.

Create Cut-Back Borders Along Woodlots and Forests

By cutting trees along woodland margins, it is easy to create brushy borders between forest and fields that will attract a variety of edge-dwelling bird species. Cut-back borders are established by removing all trees in a strip 20 to 50 feet wide bordering cropland or pasture. The increased sunlight encourages shrubby growth. A few of the largest trees can be girdled and left standing to provide nesting cavities and foraging sites for snag-using birds. The rest can add to your winter woodpile.

Cut-back borders eventually fill in with native shrubs, vines, and herbs. If you want to speed up the process, you can plant your borders with woody species that offer extra benefits for birds. Choose fruit-producing shrubs and vines, such as autumn olive, bittersweet, tatarian honeysuckle, chokecherry, crabapple, and dogwoods. In southeastern Pennsylvania, borders containing bicolor lespedeza are excellent habitat for bobwhite quail. Plant lower-growing shrubs along field or pasture edges, and taller shrubs or small trees along the woods. Among the taller plants, include some evergreen species, such as redcedar, spruces, or pines, for winter cover.

Plant Hedges and Fencerows

Well-developed, shrubby fencerows and hedges offer food, nesting sites, and shelter for many kinds of birds. They also provide travel lanes for those species that refuse to leave protective cover. In spring and summer, a mature fencerow or hedge can be alive with wild birds. In contrast, a naked wire fence has almost no wildlife value.

Wire fences can be supplemented, at first, by planting beneficial shrubs, vines, or herbs along them. In fact, brushy fencerows often develop on their own, with perching birds doing the planting. With proper care and selection of plants, a living fence can soon take over for the initial wire fence. Hedges planted along the contour conserve soil as well as wildlife.

For more open fencerows, plant American bittersweet, viburnum, and Virginia creeper. For a dense hedge, try tatarian honeysuckle, autumn olive, or dogwood. For living fences, shrubby hedges are preferred over trees because they will not sap moisture from adjacent fields, and they create less shade. You can get more ideas about establishing fencerows and hedges from your local office of the Soil Conservation Service.

Improve Waste Areas

Nearly every farm has rocky areas, sinkholes, eroded spots, gullies, or other odd areas that can not be cultivated. These waste areas can be valuable wildlife habitats if they are planted with food and cover-producing plants.

If the waste area is large, you can create a varied habitat by planting clumps of conifers for winter cover interspersed with any of the fruit-producing shrubs already mentioned. Sow a mixture of grasses, herbs, and legumes in the remaining openings. A living fence will exclude domestic stock.

Keep Livestock Out of Woodlots

On hot summer days, livestock may be attracted to the shade of a nearby woodlot. And although you may wish to keep part of it open to them, most of your woodlot should be fenced if you want to attract birds.

Regular use by livestock damages understory vegetation that many birds and other wildlife depend on. Heavy use of woodlots by livestock eventually will kill the trees, as excessive trampling compacts the soil, choking tree roots. To conserve your woodlot as a continual source of fuel, timber, and beneficial wildlife, keep livestock out. A thickly planted cut-back border around your woodlot will turn livestock away, and provide additional benefits for birds at the same time. For more suggestions on managing your woodlots, see the section on improving forested lands for birds.

Encourage Vegetation Near Streams and Farm Ponds

Areas surrounding streams and ponds can produce excellent wildlife habitat because of the potential for food, cover, and water in proximity. The first step in managing these areas for birds is to exclude livestock that trample the banks and prevent the establishment of stabilizing vegetation. If needed, stock watering places should be located in less fragile sites.

As in other habitats, clumps of evergreen shrubs and trees provide escape cover and winter shelter near ponds and streams, while fruit-producing shrubs, grasses, and legumes produce abundant food for seed- and fruit-eating birds. Insect eaters also benefit from the plentiful insect life that well-vegetated wet areas produce. Along meandering streams, shrubs should be planted only on the outside of bends; the inside should be sown in grasses and herbs. This helps prevent water from being deflected against the outside bank, deepening the curve. Some good moisture-tolerant plants you can use near streams and ponds include red-osier dogwood, nannyberry (viburnum), willows, highbush cranberry, white pine, and Norway spruce.

Bird Feeds and Feeding

If you already feed birds, you have plenty of company. Bird feeding has become a surprisingly popular activity in Pennsylvania, with nearly 75 percent of homeowners taking part. In many cases, feeding is done intermittently and the food is nothing fancier than stale bread. But 34 percent of Pennsylvanians have bird feeders on their properties; and many of these are regularly stocked, at least during the critical winter months, with bird seed or seed mixes that are readily available from feed stores and local supermarkets.

As its popularity has increased, bird feeding has become big business in the United States. In 1980, Americans spent $517 million on bird seed alone, plus untold millions on feeders and other bird-care products.

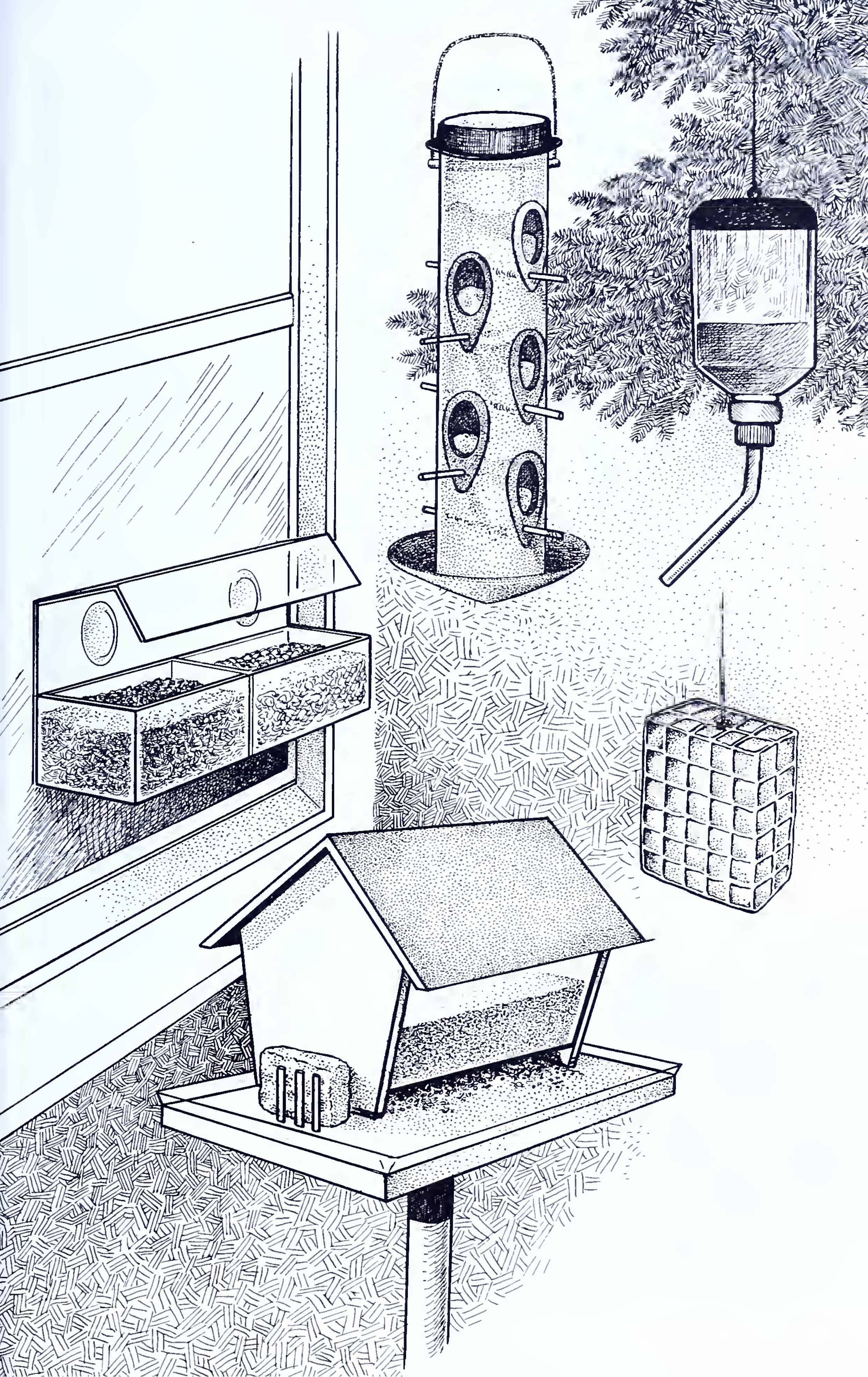
The kinds of birds you attract to your feeders will depend partly on the kinds of foods you provide. Different bird species have their own preferences. If you want to attract a varied collection of birds, the menu will need several choices of food types. There are four main categories of bird foods you should consider — seed, suet, fruit, and nectar.

"Bird seed" is the most variable of the food types, and probably the least understood by the purchaser. It can range from a single seed species to carefully blended mixtures of several kinds of seeds. Sunflower seeds (both the striped and black oil varieties), cracked corn, and thistle (niger) seed can often be purchased individually. Commercial mixes vary in composition, but frequently include millet, sunflower seed, cracked corn, milo, and wheat.

It pays to be concerned about the composition of your bird seed, because both the cost and the attractiveness of different seeds vary greatly. The accompanying table shows which bird species are attracted to different kinds of seeds. By changing the mixture of seeds you provide, you have some control over the kinds of birds that will visit your feeders. If you have only one feeder, a good all-around seed mixture might contain mostly sunflower seed, white millet, and cracked corn. Because of its high cost, thistle seed is rarely added to seed mixes. Of course, no assortment of foods will attract birds if the habitat surrounding the feeder is not to their liking. Refer to the previous sections for suggestions on habitat improvement.

Seed mixes containing a high percentage of non-preferred seeds, such as milo, should probably be avoided. These mixes produce considerable waste when the birds pick out what they like and scatter the rest. Unfortunately, these are often the less expensive seed mixes. Although you will pay more, you will get more bird visits and more enjoyment for your dollar if you buy a higher quality mix.

Bird seed can be presented to wild birds in many ways. Scattering seed on the ground is the simplest. Because some seeds are trampled rather than eaten, this method can be wasteful. A better method is to build a feeding tray with a raised edge and attach it to a window sill, or elevate it on the end of a half-inch pipe driven into the ground. But even on a tray, seed is quickly scattered by over-eager songsters. The best way to put out bird seed is in a feeder that dispenses the seed as it is used, thus minimizing waste. Some useful feeder designs are illustrated nearby. Many types of feeders are sold in hardware and garden stores, and some



mail-order companies specialize in bird-care products and offer many unique and efficient designs. Some are even squirrel-proof! We suggest that you write to the following vendors for catalogs and current prices:

Audubon Workshop, Dept. 799, Northbrook, IL 60062
Duncraft, Inc., Penacook, NH 03303
Hyde Bird Feeder Co., Box 0168, 56 Felton St., Waltham, MA 02254

Some non-profit organizations also sell supplies for backyard feeding stations. Foremost among these are:

National Audubon Society, 950 Third Ave., New York, NY 10022
National Wildlife Federation, 1412 16th St., N.W., Washington, D.C. 20036

Not all birds are seed eaters. The fascinating woodpeckers, for example, rarely come to seed feeders. But woodpeckers and other birds, such as nuthatches and chickadees, are readily attracted to suet feeders during winter. Suet is beef fat that can be bought in chunks at any meat market. Pieces of suet can be placed directly into feeders, or they can be rendered down, mixed with bird seed or peanut butter, and formed into uniformly shaped suet cakes.

Feeding birds is a popular activity, especially in winter. By using appropriate feeders and following the recommended foods for specific kinds of birds, a person can attract a great variety to within easy viewing distance.

Suet feeders are sold commercially, or can be constructed at home out of wood or hardware cloth. For an easier, less expensive way to attract woodpeckers, try a more natural approach. Force some softened suet into shallow crevices in trees, or drill some one-inch holes a half-inch deep into a piece of wood, fill the holes with suet, and fasten the board in a tree.

During summer and fall, fruit-eating birds, like catbirds and waxwings, can sometimes be attracted to fruit feeders containing apple, orange, banana, or berries. The larger fruits should be partly peeled to give the birds a place to start. In the proper habitat, fruit eaters are often more readily attracted to fruit-bearing trees and vines, such as flowering crabapples, cherries, and strawberries.

There is only one species of nectar-feeding bird in Pennsylvania — the ruby-throated hummingbird. Hummingbirds are common breeding residents of the state and are readily attracted to brightly colored garden flowers such as honeysuckle, phlox, salvia, impatiens, and petunia. Hummingbirds can also be attracted to special feeders containing sugar solution (prepared by adding one part honey to four parts boiling water) or a commercial artificial nectar. Adding some red food coloring to the sugar solution or tying a red bow on your feeder may make it more attractive. Birds in general have acute color vision, and hummingbirds have a marked preference for red.

Man-made Housing for Birds

In environments dominated by man, nesting sites for wild birds can often be in short supply, particularly for the hole nesters. Many of the old, cavity-prone trees that once dotted our farming areas are gone. In town, trees are carefully pruned and patched, and removed if they show signs of decay. To some extent, we can compensate for the loss of these natural nesting sites by providing man-made housing.

One bird species that has been particularly hardhit by the loss of suitable nesting sites is the eastern bluebird. In the last 40 years, bluebird populations may have fallen by as much as 90 percent. Bluebirds used to nest in natural crevices and abandoned woodpecker holes in scattered old trees around farms and along forest margins. Their populations plummeted as many of these trees were removed to simplify cultivation, and as starlings and house sparrows competed intensely for scarce nesting holes. Bluebirds are readily attracted to nest boxes in their preferred savannah-like habitats around farms, orchards, and open fields. A grassroots campaign to save the bluebird has produced "bluebird trails" in many parts of the United States and Canada. Bluebird trails are generally stretches of country road

BIRD PREFERENCES FOR DIFFERENT SEED TYPES

Seed	**Species Preferences**
White proso millet	Highly preferred by dark-eyed juncos, mourning doves, tree sparrows, song sparrows, house sparrows, brown-headed cowbirds, and white-throated sparrows.
Sunflower seed (black oil type)	Highly preferred by American goldfinches, cardinals, evening grosbeaks, house finches, mourning doves, and purple finches, (also eaten readily by birds preferring striped sunflower).
Sunflower seed (striped type)	Highly preferred by blue jays and tufted titmice (also eaten readily by birds preferring oil sunflower).
Thistle (niger) seed	Highly preferred by American goldfinches; eaten readily by house finches, purple finches, mourning doves, song sparrows, and dark-eyed juncos.
Canary seed	Eaten readily by dark-eyed juncos, mourning doves, brown-headed cowbirds, and many sparrows and finches.
Cracked corn	Preferred by common grackles, and readily eaten by dark-eyed juncos, blue jays, and tree sparrows.
Peanut hearts	Highly preferred by starlings; eaten readily by species that use millet.
Red millet	Eaten readily by those species preferring white millet.
Milo (sorghum)	Not preferred by any species; eaten by brown-headed cowbirds, starlings, mourning doves, and house sparrows.
Wheat	Not preferred by any species; eaten by mourning doves and brown-headed cowbirds.
Hulled oats	Attractive only to starlings.
Flax seed	Eaten sparingly by few species.

Recommended Dimensions and Heights for Nesting Boxes and Shelves

Species	Floor of Cavity	Depth of Cavity	Entrance above Floor	Diameter of Entrance	Height above Ground
	Inches	Inches	Inches	Inches	Feet
Bluebird	5x5	8	6	1.5	5-10
Chickadee	4x4	8-10	6-8	1.12	6-15
Titmouse	4x4	8-10	6-8	1.25	6-15
Nuthatch	4x4	8-10	6-8	1.25	12-20
House wren	4x4	6-8	1-6	1.0	6-10
Tree swallow	5x5	6	1-5	1.5	10-15
Purple martin	6x6	6	1	2.5	15-20
Prothonotary warbler	6x6	6	4	1.5	2-4
Starling	6x6	16-18	14-16	2.0	10-25
Flicker	7x7	16-18	14-16	2.5	6-20
Red-headed woodpecker	6x6	12-15	9-12	2.0	12-20
Downy woodpecker	4x4	9-12	6-8	1.25	6-20
Hairy woodpecker	6x6	12-15	9-12	1.5	12-20
Screech owl	8x8	12-15	9-12	3.0	10-30
Barn owl	10x18	15-18	4	6.0	12-18
American kestrel	8x8	12-15	9-12	3.0	10-30
Wood duck	10x18	10-24	12-16	4.0	10-20
American robin	6x8	8	——*	——*	6-15
Barn swallow	6x6	6	——*	——*	8-12
Phoebe	6x6	6	——*	——*	8-12

***Leave one or more sides open.**

through suitable habitat along which bluebird nest boxes have been erected at intervals of at least 100 yards. One particularly ambitious trail in Canada extends nearly 2,000 miles through the prairies of Manitoba and Saskatchewan, and contains some 7,000 nest boxes. In 1976 alone, this bluebird trail produced 8,000 young bluebirds, plus another 15,000 tree swallows. Trails of bluebird nest boxes can be instrumental in restoring this beautiful songster to its former haunts.

Not all cavity nesters have suffered from man's cosmetic tinkering with the environment to the extent that the eastern bluebird has. But in both urban and rural areas, nest boxes provide homes that might otherwise be in short supply.

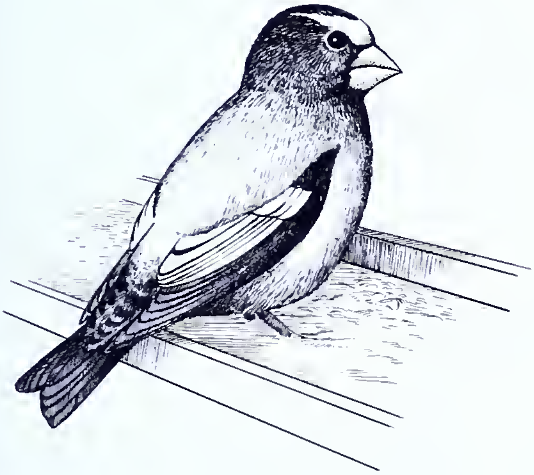
Nest boxes must be built and hung with a specific occupant in mind, because each species has different needs for roominess and height above the ground. The diameter of the entrance hole is a particularly critical dimension; it gives only certain birds access to the nesting chamber and excludes others that might interfere. The bluebird nest box with its 1.5-inch entrance is safe from disturbance by starlings and cowbirds, and a properly built wren house can be entered by no other species.

Most birds are very aggressive around their nesting sites, and will drive off intruding birds of their own species. For that reason, most species prefer single accommodations. Purple martins are the apartment dwellers of the bird world. Martin houses usually contain at least six individual units, and may contain several hundred.

In general, natural-looking nest boxes are more readily accepted by house-hunting birds than conspicuous ones. An unpainted wooden box works best. Rustic houses can be made from rough-cut boards or bark-covered scrap from a sawmill. Split sections of log can be hollowed out with a chisel, then hinged back together. Wrens and martins find hollow gourds accommodating. A perch at the entrance hole of any nest box is an unnecessary embellishment, and may attract unwanted starlings. In all cases, nest boxes should have drainage holes in the floor and be hung in protected places where the rain won't blow directly in, generally facing south or east.

Not all birds will use nest boxes. Robins, barn swallows, and phoebes prefer nesting shelves that are open on one or more sides. In a protected place under the eaves of your house or farm buildings, these birds will adorn the platforms to suit their own needs.

The cavity-nesting eastern bluebird is the beneficiary of many artificial nest box programs. The elimination of suitable nest sites and competition from more aggressive starlings and house sparrows have caused bluebird numbers to plummet during the last several decades.



BIRD CONSERVATION AND STUDY

The Beginnings of Bird Conservation

The conservation movement in America was born at the dawn of the 20th century. It was given life by an alarmed citizenry which was witnessing the annihilation of species whose numbers were once thought to be inexhaustible. By the 1890s, the passenger pigeon was gone. Only two decades before, a single nesting colony of these pigeons in Wisconsin covered an area of 750 square miles and contained no fewer than 136 million birds. Word of the vast nesting spread among the hunters and trappers who supplied eastern markets. By the thousands they converged on the nesting area and laid it waste. Millions of dead birds were shipped by rail to market, while the others were scattered, their nesting a failure.

Pennsylvania was among the first to pass laws protecting the passenger pigeon — an 1875 act prohibited killing or disturbing the birds on their nesting grounds. Unfortunately, it was already too late. The last pigeon roosts had vanished from the state some years before.

The decimation of the passenger pigeon, and the equally extensive annihilation of the vast bison herds that once blackened the Great Plains, shocked the public out of its apathy and spurred a new era of wildlife conservation. But these were not the first species to vanish at the hand of man. The passings of the great auk in 1844, the Labrador duck in 1875, and the Carolina parakeet in 1904, were less heralded than the demise of the passenger pigeon, but as the list of threatened and extinct American wildlife grew, pressure mounted for protective measures.

Some of the earliest wildlife laws were prohibitory measures designed to stamp out the uncontrolled slaughter, primarily by market hunters. In 1897, Pennsylvania laws made it illegal to shoot wild ducks during spring, and prohibited the sale of game birds killed in the state. An earlier law, in 1889, gave protection to song and insectivorous birds, and in 1907 the use of autoloading guns in hunting game was prohibited in the commonwealth. These early state laws foreshadowed similar legislation at the federal level.

The establishment of refuges and managed hunting areas was a second early form of wildlife conservation that has expanded greatly since its modest beginnings. The first federal wildlife refuge, Florida's Pelican Island, established in 1903, protected a four-acre nesting colony of seabirds from plume hunters. Today the National Wildlife Refuge system encompasses more than 45 million acres of land and water. The Pennsylvania Game Commission's land-acquisition program got underway in 1920 with the purchase of 6,288 acres in Elk County, the first of well over a million acres of State Game Lands in existence today.

Another early attempt at game conservation, at least from the hunter's point of view, was the imposition of bounties on that much-maligned group of animals, the predators. It was believed there would be more game for the hunter if he didn't have to share it with the "vermin." In fact, the earliest wildlife law in Pennsylvania's history was a 1683 bounty on wolves. Through the years, bounties were put on red and gray foxes, mountain lions, bobcats, skunks, mink, weasels, and most species of hawks and owls, and more than $5 million dollars was paid out to Pennsylvanians between 1915 and 1966, when the last bounties were wisely removed. Today, predators are valued for the role they play in reducing rodents and other pests, for the income their pelts earn for Pennsylvania trappers, and for their very existence as symbols of our frontier heritage and as part of the natural world.

Perhaps the most important and effective conservation measure ever devised also had its roots at the end of the 19th century, when the plight of our vanishing birds and other wildlife first focused public attention and prompted action. This was the beginning of conservation education. Under the theory that people would move to protect wild creatures once they learned to appreciate them, the first "Bird Day" was observed in the Oil City public schools in 1894. Soon this idea spread across the nation. About the same time, the first "Audubon Societies" were formed — Pennsylvania's was chartered in 1896. These scattered organizations were amalgamated in 1905 into the National Association of Audubon Societies for Protection of Wild Birds and Animals, later to become known simply as the National Audubon Society. The Audubon Societies were responsible in large part for the end of plume hunting that served the millinery trade, and they pushed legislation to protect wildlife throughout the nation. Their magazine, *Bird-Lore,* started in 1899 by ornithologist Frank M. Chapman, brought interesting information on birds and conservation into many American homes. These and other early efforts at public education, which have continued and mushroomed until the present time, were largely responsible for the burgeoning conservation movement in America, and made all subsequent progress in this endeavor possible.

Flocks of passenger pigeons reportedly darkened Pennsylvania's skies in years gone by, but disease, the loss of suitable habitat and market hunting made this species extinct in a short period of time.

Laws Protecting Birds

International Treaties

Migratory birds are not the domain of any one state or even one country. In their annual treks across the length and breadth of the continent, they cross many political boundaries. Conservation of these unfettered world travelers therefore requires cooperation among states and among nations.

The single most important agreement on the conservation of North American birds was signed in 1916 by the United States and Great Britain, representing Canada. Called the Migratory Bird Treaty, this agreement gave protection to most species of birds that migrate between the U.S. and Canada. The treaty was put into effect in 1918 with the passage of the federal Migratory Bird Treaty Act. The act put the responsibility for protection of migratory birds in the hands of the federal government, rather than the individual states. It gave complete protection to most nongame birds, their eggs and nests, and established closed seasons on migratory game birds. The act allowed hunting of game birds during specific open seasons agreed upon by the federal government and the states, and permitted the killing of birds in certain nuisance situations. In 1936, a similar treaty was signed by representatives of the United States and Mexico.

The snowy egret was a popular target for plume hunters at the beginning of this century. The alarm created by this practice led to the establishment of our nation's refuge system and ultimately to a united conservation movement.

These international treaties initially denied protection to a large and maligned group of birds, the birds of prey. Early in this century, predatory birds were thought to be harmful to man's interests. But as more and more evidence of the benefits of these birds accumulated, public pressure mounted to extend protection to them as well. Finally, in 1972, complete federal protection was granted to migratory hawks, eagles, ospreys, owls, vultures, and members of the crow family.

Other Federal Laws

On July 4, 1776, the day of the signing of the Declaration of Independence, the assembled founders instructed Benjamin Franklin, John Adams, and Thomas Jefferson to choose a national emblem. Over Franklin's objections — he preferred the wild turkey — they selected a seal containing the bald eagle as its central figure. This seal was officially adopted by Congress on June 20, 1782, but no special consideration was given to the wild eagles that inspired our nation's emblem. It was not until 1940 that the Bald Eagle Act gave specific and total protection to the remaining populations of bald eagles. A 1962 amendment extended the same protection to golden eagles.

Although various early laws and treaties put an end to unrestricted killing of most birds, these measures were not sufficient to reverse the decline of some species whose populations were dwindling because of loss of habitat or other factors. The Endangered Species Act of 1973 attempted to reverse these trends. It provided federal assistance for rare and threatened wildlife and plants, and encouraged states to establish their own endangered species programs. The act authorized the U.S. Fish and Wildlife Service to develop lists of endangered species; prohibited their destruction, possession, or sale; and authorized the purchase and protection of critical habitats. The act also recognized that a species may be endangered within a particular state, even if it is plentiful elsewhere.

The Pennsylvania Game Law

All birds in the commonwealth, except the introduced house sparrow and starling, are protected by either federal or state laws. The federal Migratory Bird Treaty Act covers all species that regularly move across state lines. It permits open seasons on migratory game birds, under the supervision of the U.S. Fish and Wildlife Service.

Those birds that spend their lives within the boundaries of the commonwealth are protected under Pennsylvania's Game Law. The law forbids the killing of any protected bird or of game birds out of season, and prohibits the destruction of bird nests or eggs. Even dead birds are covered by the law — if you should find a dead bird along the roadside, you may not legally keep any part of it. The setting of open seasons and bag limits on our resident game birds, such as grouse and turkey, is the responsibility of the Game Commission, which regularly solicits opinions from sportsmen and other citizens' groups.

More on Bird Conservation

Bird Refuges

Bird refuges may range in size from a single backyard to many square miles. They may be owned by individuals, groups, state governments, or the federal government. And they may be established for a variety of reasons. About all they have in common is that any refuge provides a haven for birds during at least part of the year.

Refuges are usually much more effective in attracting and encouraging birds if they are carefully managed to provide whatever the birds need (see Attracting Birds to Your Land). An inviolate refuge, or sanctuary, is often short lived, because it eventually "grows up" and becomes unsuitable for many of the birds it was meant to help. Applying the principles of wildlife management, however, can make a refuge perpetual. Often, hunting is permitted on refuges, if that is compatible with their management goals.

The National Wildlife Refuge system has two units in Pennsylvania, both administered by the U.S. Fish and Wildlife Service. The 8,000-acre Erie NWR near Guys Mills in Crawford County was established primarily as a stopover for migrating waterfowl. The Tinicum National Environmental Center is a truly unique addition to the federal refuge system. Established in 1972 within Philadelphia's city limits, the Tinicum NEC seeks to rehabilitate and protect Tinicum Marsh, which in the past was badly misused as a dump for both solid and liquid waste. Tinicum serves as a stopover and wintering area for large numbers of migrating water birds.

The 25,000-acre Pymatuning Waterfowl Area in Crawford County is one of several waterfowl refuges managed by the Pennsylvania Game Commission. Primarily a stopping place for vast numbers of waterfowl, Pymatuning also provides breeding areas for mallards, black ducks, and blue-winged teal, and year-round habitats for an impressive array of nongame birds. The Pymatuning region is one of the best birdwatching areas in the state. Other state-owned bird refuges include the hundreds of State Game Lands scattered throughout the commonwealth and several special wildlife propagation areas that are closed to the public.

The best-known private bird refuge in Pennsylvania is Hawk Mountain Sanctuary, perched atop the Kittatinny Ridge in Schuylkill County. From its two major lookouts, approximately 25,000 hawks are counted each year during their spectacular fall migration. Before 1934, these same lookouts attracted hawk shooters who slaughtered thousands of the birds as they passed by at close range. Today, owned and maintained by the Hawk Mountain Sanctuary Association with private contributions, the preserve is a mecca for bird lovers the world over, and a center for research on hawk migration. The best time to visit the sanctuary is during September, October, and November. Each month brings a different selection of these magnificent birds as they sail effortlessly past the lookouts.

Other lands in the commonwealth do double duty as bird refuges even if they were set aside for other reasons and are not managed specifically for birds. Chief among these are the national, state, and city parks that frequently offer excellent birdwatching opportunities.

Restoring Rare and Endangered Birds

The federal Endangered Species Act of 1973 encouraged states to develop programs of research and restoration for birds and other wildlife in danger of disappearing from individual states. The Pennsylvania Game Commission responded to the challenge by helping to sponsor a conference on "Species of Special Concern," at which scientists and amateurs from across the state met to discuss proposed lists of Pennsylvania's threatened and endangered wildlife. The lists contained the names of 38 birds, ranging from the osprey, peregrine falcon, greater prairie chicken, and others that have been extirpated from the commonwealth, to the goshawk, yellow-bellied sapsucker, whip-poor-will, and others whose status is uncertain.

As a start, the Game Commission concentrated its efforts on three of our vanishing birds of prey — the bald eagle, osprey, and peregrine falcon. Of the three, only bald eagles still bred naturally in the state — four active nests were monitored near Pymatuning in 1981. Besides protecting the eagles' nesting area, the Game Commission introduced baby eagles from the Fish and Wildlife Service into Pennsylvania's eagle nests, where they were adopted willingly by the foster parents.

Because ospreys and peregrine falcons no longer nested in the commonwealth, foster parents were not available to raise introduced young. Instead, falcons and ospreys were introduced by the process of "hacking," which means that young birds were placed in likely nesting sites and raised to fledging age by cooperating humans. In the hacking process, care is taken to minimize direct contact with the birds — the goal is to produce wild adults that are not dependent on man for their survival. The Game Commission hopes that, when the birds reach maturity, they will return to nest in the vicinity of the release sites. Peregrines have been reintroduced into downtown Philadelphia from a hack site atop a prominent building, and ospreys have been raised at sites along the Susquehanna. All three species — bald eagle, osprey, and peregrine falcon — have much brighter futures now. With luck and continued encouragement, they will never follow the passenger pigeon into oblivion.

"Working Together for Wildlife"

Since 1913, when the Game Commission sold its first hunting license, wildlife management in the commonwealth has been funded primarily with sportsmen's dollars. With these funds, the Commission has purchased the State Game Lands, established propagation areas and refuges, raised game birds, improved habitats, carried out wildlife research, and produced educational materials, primarily with the hunter in mind. Nongame species have benefitted tremendously by the Commission's efforts, but in the past they were rarely a primary concern.

In 1980, the Game Commission launched a program to give nonhunters and hunters alike the opportunity to participate in research and management of Pennsylvania's nongame wildlife. Called "Working Together for Wildlife," the program allows residents to contribute to a nongame fund. Conservationists may purchase a handsome embroidered patch and a decal depicting one of the species the fund will help conserve. Each year the Commission produces a different patch and decal — you can collect the whole colorful series with a regular annual contribution.

The 1982 patch pictured an osprey, one of the first species to benefit from the nongame fund. The Working Together for Wildlife program is supporting a multi-year effort to reintroduce ospreys to their former haunts in Pennsylvania. Other species that are being helped by the program include the eastern bluebird, bald eagle, and peregrine falcon.

Organizations can help conserve Pennsylvania's nongame wildlife by soliciting contributions for the Working Together for Wildlife program. The Game Commission will provide patches and decals on consignment, to be given to anyone who contributes $3 or more. The Commission will refund 20 percent of the contributions you raise to your organization's treasury.

Caring for Injured and Orphaned Birds

All birds in Pennsylvania, except house sparrows and starlings, are protected by law. It is illegal to disturb bird nests or young, or to capture any wild bird without the proper state and federal permits.

Despite this, many people find it impossible to pass up injured or orphaned birds that are in obvious distress — and there is no reason that they should if they are *positive* the bird is in serious trouble, and if they realize what they are getting into when they decide to care for it. Raising an orphaned songbird is a considerable responsibility. The baby must be housed somewhere safe and warm, and may require feeding every 15 minutes throughout the day.

The reestablishment of the bald eagle in the central and eastern portions of Pennsylvania is just one of many nongame-oriented projects conducted with funds donated to the Game Commission's Working Together For Wildlife program.

The most common mistake that well-meaning people make is to adopt an orphan that is not orphaned at all. Flightless baby birds often spend their last few days before fledging running around on the ground or scrambling through the shrubbery, where they are still fed regularly by their parents. If you don't see a parent nearby, chances are that it is hiding in the brush, waiting for you, the intruder, to leave. Very young birds that have fallen out of the nest should be returned to it if at all possible, or you can make an artificial nest of tissue in a basket and hang it where the parents will find it. You should never adopt a baby bird unless you are certain the parents are dead, or the baby is in obvious poor condition from lack of food.

Baby songbirds can be housed in a box lined with soft tissues and equipped with a 60- to 100-watt bulb for warmth. Maintain the nest temperature at 95 degrees, night and day, until the bird is well feathered, then reduce the temperature by about 5 degrees each week, until the bird no longer huddles in the warmth of the light. As the growing bird becomes more active, transfer its nest and light to a large cage.

All altricial birds, except doves, can be fed a simple diet of commercial dried cat chow, moistened with a mixture of egg yolk and milk. Fashion pea-sized morsels of the softened food and insert them well down the throat of the gaping baby, until the swallowing reflex takes over. If the bird is too weak to gape, gently pry open its beak and insert the food. Feed the baby as much as it wants at least every half-hour, and never miss a meal. After feeding, offer a few drops of water from the end of your finger until the bird refuses to gape. As the baby grows, offer it more and more foods that are similar to what it may find in the wild — perhaps a commercial starter mash for seed eaters, and bits of canned dog food or hamburger for insect eaters.

Baby doves should be fed an artificial "pigeon's milk" consisting of cooked wheat cereal mixed with powdered infant formula and diluted with water. Offer the mixture in the bulb of an eyedropper or cut-off nipple from a baby bottle. The baby dove will insert its bill into this container and suck up its contents. As the bird grows, provide grit, bird seed, and water in its cage. Baby ducks, grouse, and other precocial birds can be fed commercial starters available at feed stores.

Baby birds should be released gradually into the wild, first by putting their cage where they can see and hear other birds, then by leaving the cage door open so the bird can venture out. As it matures, take the orphan into the yard every day and let it fly. You can put the cage outside in a sheltered spot that is safe from cats, stock it with food and water, and let the bird use it for a home base until it is completely independent. The eventual goal in caring for any baby bird is to release it into the wild. Under no circumstances may you keep a protected bird as a pet.

Injured and orphaned birds of prey offer some special problems. Fortunately, there are more than a dozen licensed raptor rehabilitators in Pennsylvania who have the knowledge and experience to care for these birds and, if possible, introduce them back into the wild. Your local Game Protector can put you in touch with a rehabilitator near you. To tide them over, very young hawks and owls can be fed the same mixture of cat food, egg yolk, and milk as baby songbirds. Offer them as much as they want every three hours. Older chicks should be fed whole mice, torn in pieces if they are unable to do this for themselves. For a couple days, you can feed strips of beef heart dipped in egg yolk, but this is not a complete diet and will not sustain them for long without vitamin and mineral supplements.

Your public library or bookstore may have manuals on caring for orphaned and injured animals which you will find useful. Two that we have seen are:

Wild Orphan Babies: Mammals and Birds, by William J. Weber.

The Complete Care of Orphaned or Abandoned Baby Animals, by C. E. Spaulding and Jackie Spaulding.

Ways Scientists and Amateurs Study Birds

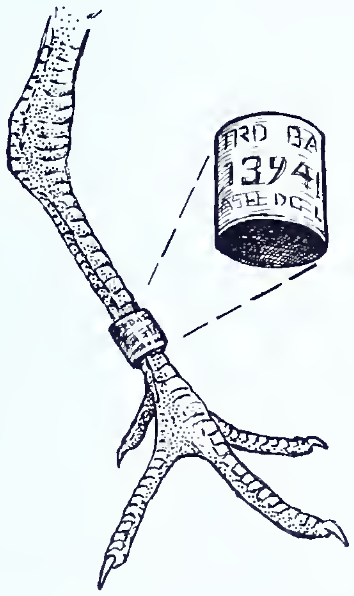
Valuable information about wild birds comes from many sources — from professional ornithologists, wildlife biologists and managers, university students, members of local birdwatching clubs, and individual homemakers, farmers, business people, and many others. In fact, it is the amateur ornithologist who has contributed the most toward our understanding of bird habits, movements, and population trends. For every professional, there are hundreds of interested amateurs. When organized into a cohesive force, this volunteer army of bird enthusiasts can provide vast quantities of information of tremendous value in the conservation and management of wild birds.

Bird Banding

To follow their movements and determine their life spans, birds must be marked so that they are individually recognizable. The most effective marking technique for wild birds is banding. Called "ringing" in Europe, bird banding consists of applying a numbered aluminum bracelet to the bird's leg, just above the foot. Besides the unique serial number, the band is stamped with a request to advise the U.S. Fish and Wildlife Service in Washington, D.C. The government depends on a cooperative public for information on recoveries of banded birds. Whenever a banded bird is found dead or captured alive, the finder should remove the band (only if the bird is dead) and mail it to the Fish and Wildlife Service along with a brief note explaining when and where the bird was found and how it may have died. The Service responds to every note it receives by sending the finder a report on when and where the bird was banded, and notifying the original bander that one of his birds has been recovered.

Because all migratory birds are protected by international treaties and federal law, a federal permit issued by the U.S. Fish and Wildlife Service is required of all banders in the United States. The Canadian Wildlife Service issues similar permits to Canadian banders. In Pennsylvania, as in many states, an additional state banding permit is also mandatory. Banding permits are issued only to highly qualified individuals who have legitimate scientific reasons for wishing to capture and mark migratory birds. Because of the enormous number of bandings that take place each year and the immensity of the job of maintaining banding records, few permits are issued to hobbyists anymore. Bird banders must be able to identify all birds they catch, as well as determine the age and sex of any bird by examining subtle variations in plumage texture, color of the eyes, mouth, or feathers, length of the wings, or extent of ossification of the skull.

In North America, more than a million birds are banded each year, and more than 40 million birds have been banded since 1920, when the program officially began. Banding records for all of North America are maintained by the Fish and Wildlife Service's Bird Banding Laboratory in Laurel, Maryland. The laboratory routinely provides banding and recovery records from its computerized files to scientists and others who have a need for them.



Since the bird banding program began in 1920, over two million bands have been recovered and returned. If you should happen to find a banded bird, report the number to: Migratory Bird Population Study, U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, MD 20811.

Much of the information known about bird migrations, distributions and lifespans comes from the extensive banding programs in North America and Europe.

Capturing Wild Birds for Banding

Perhaps the most common way to catch wild birds alive is in some kind of a trap, usually baited with a favorite food. Sparrows, finches, and other seed eaters are easily caught in cages whose trap doors close when the bird hops on a perch-like trigger inside. Many songbirds, and some waterfowl, are caught in traps with funnel-shaped entrances that narrow to a small interior opening. The birds become trapped because they can't find the way out in time as the bander approaches. Small hawks are often caught with a special trap called a bal-chatri. It consists of a wire cage containing a live starling or pigeon for bait. When the hawk swoops down upon its would-be prey, its feet become snared in a tangle of loops made of monofilament fishing line secured to the top of the cage. In this way, the bander gets his hawk and the starling survives to lure in another bird.

Used in the Orient for decades to capture birds for the market, but only brought to the United States in the 1950s, mist nets are used to catch most small birds, especially those that can not be baited easily. Modern mist nets consist of fine nylon or polyester mesh that is almost invisible when erected in front of shrubs or other vegetation. A standard mist net is about 35 feet long and 7 feet high, making an undetected wall that small birds fly into, becoming safely entangled until the bander sets them free.

Larger birds, such as ducks, geese, and turkeys, can be caught alive by firing a net over them as they feed at a bait station. Cannon nets or rocket nets are generally secured to the ground along one edge while the other edge is blasted over the surprised birds with black powder-powered projectiles.

Finally, many waterfowl and upland game birds, such as woodcock and pheasants, can be captured at night by dazzling them with a bright light. The birds become mesmerized by the approaching spotlight, and often sit tight long enough to be caught with a long-handled net.

Radiotelemetry

Recent advances in electronics have made it possible to attach miniature radio transmitters to free-living birds. This allows scientists to monitor their daily movements within small study areas, or even, with aircraft, to follow their migratory flights. Tiny transmitters may be glued, sewn, or clipped to the birds' feathers. In this way, the transmitter is shed harmlessly when the bird molts. Alternatively, a radio package may be attached with a harness made of latex surgical tubing, which decomposes and drops off after it has done its work.

The smallest transmitters are powered by tiny batteries like those used in wristwatches and hearing aids. They generally transmit radio signals for only two to four weeks before the battery dies. Their effective range is usually much less than one mile, and varies depending on terrain and the amount of vegetation between the transmitter and the receiver. Larger radio packages, such as those used on turkeys, have a useful life of about six months and a range of a mile or more.

By avoiding obstacles on the ground that may absorb radio signals, receivers mounted in aircraft can often pick up signals at much greater range than ground-based receivers.

Radio-equipped birds are pinpointed by triangulation from at least two widely separated receiving locations. Two bearings are needed because a single bearing can tell only in which direction the transmitter lies, not how far away it is. However, the instrumented animal is easily pinpointed where two separate bearings cross.

Bird Surveys and Counts

Each year, tens of thousands of amateur ornithologists across the United States and Canada participate in one of the largest, most extensive, and longest running bird surveys in history. The National Audubon Society's Christmas Bird Count was begun in 1900, the brain child of Frank M. Chapman, one of the self-taught pioneers of American ornithology. In 1980, more than 100 million birds of 600 species were counted by over 30,000 volunteer participants at 1,300 different sites. In a Christmas Count, a varying number of participants tallies as many different wild birds as possible within a circle 15 miles in diameter during a single day, usually within a week of Christmas. The results of the counts are published each year in the Audubon Society's journal *American Birds,* along with the names of all participants.

The decades of accumulated data from the Christmas Bird Counts constitute a priceless record of winter bird distribution and abundance across the continent. Scientists have used this information to document range expansions by bird species, examine population trends, and study geographic variations in avian diversity.

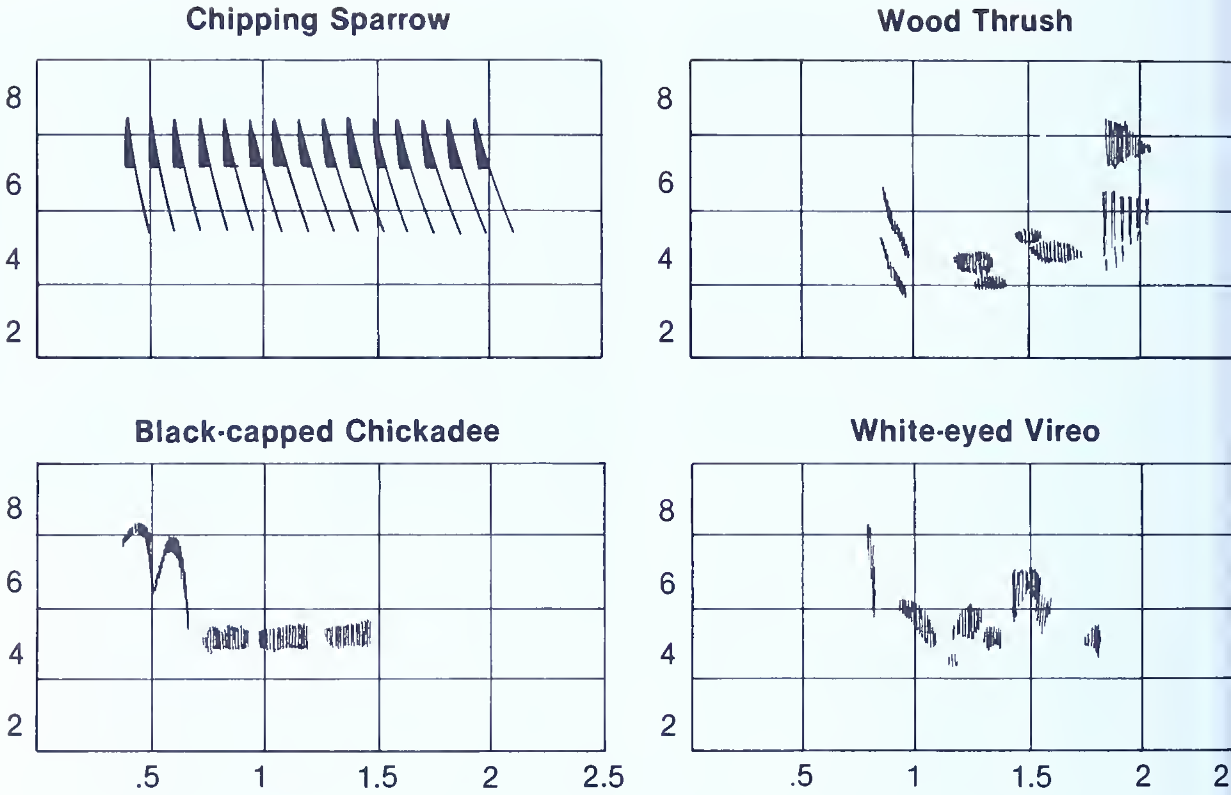
To complement the Christmas Bird Count, the Audubon Society sponsors a Breeding Bird Census, in which cooperators delineate a small area of homogeneous habitat and count all breeding songbirds within it each year. Counts are made repeatedly during each breeding season to be sure that no birds are missed, primarily by tallying singing males on their territories. Based on information from the Audubon breeding bird census and other sources, the total population of land birds in the United States was once estimated to be more than 5 billion birds.

In 1965, the U.S. Fish and Wildlife Service and the Canadian Wildlife Service initiated their own breeding bird survey, using more than 200 randomly selected sections of little-used roads scattered throughout the two countries. All birds seen and heard are counted during 50 three-minute stops at half-mile intervals. The primary purpose of the survey is to monitor population trends for each species of bird. Results of the survey for Pennsylvania show that, over the last decade or so, populations of mallards, American kestrels, house wrens, and wood thrushes have increased, while bobwhite quail, horned larks, vesper sparrows, and yellow-breasted chats have all declined.

Studying Bird Migrations

By recovering banded birds that die during migration, biologists can chart migration pathways — but they can't tell from such evidence when, how fast, or how high migrating birds fly. One way to answer these questions is by "moon watching" — that is, using a telescope at night to watch migrating birds as they pass across the face of the full moon. On a good night during the peak of migration, about 30 birds might be seen per hour. When one considers that the moon occupies only about 1/350th of the diameter of the night sky, the total number of birds winging by must be incredible.

A more sophisticated technique for studying bird migration involves the use of radar equipment similar to that used to track aircraft. Although it is often difficult to determine the number


Chipping Sparrow

Wood Thrush

Black-capped Chickadee

White-eyed Vireo

Sonograms such as these allow scientists to identify not only species of birds but also individual birds of the same species. This specialized equipment has provided ornithologists with answers to many questions about why birds sing.

or species of birds in the cloud that may appear on a radar screen, it is relatively easy to measure the altitude, speed, and direction of travel of migrating individuals or flocks, day or night, often at considerable distances.

Pictures of Bird Songs

A bird's song is as much a part of it as its feathers. Subtle variations in song can distinguish different species of birds, different races within the same species, or even different individuals in a small woodlot. At one time, the study of bird song depended upon the hearing of the observer, but today songs can be transformed into unique patterns of blotches and squiggles on a strip of paper. The device one uses to create pictures of sounds is called a sound spectrograph, or sonograph, and the pictures are known as sonograms.

The sonograph reduces a tape-recorded bird song to a graphic form, with the frequency, or pitch, of the notes on one axis and time on the other. Loudness is indicated by the darkness of the pattern. Thus a sonogram of the flutelike, ascending song of the Swainson's thrush appears as a characteristic series of blotches rising through time. Sonographs record details of bird songs that are impossible to detect by hearing alone, allowing ornithologists to capture and precisely identify the recognizable vocal signatures of individual birds.

OBSERVING BIRDS

There are many approaches to watching birds. Scientists may systematically observe the behavior of a group of individuals of a particular species, aiming toward a specific research goal. Hunters learn to identify the many species of game birds. But anyone who notices a bird flying overhead or perched on a fencepost also is ''watching'' birds, even if he or she is not ''studying'' them. For the amateur, watching birds can be enjoyable as a casual hobby, simply because wild birds are so conspicuous and numerous — more numerous, for example, than wild mammals. Thus birds are encountered often, and with little effort.

Anyone who would like to be able to distinguish among the hundreds of species of birds which reside in Pennsylvania probably will want to purchase a pair of binoculars. It is difficult to identify one individual among the many species of forest-dwelling warblers, or to determine which type of hawk is soaring overhead, unless some physical details are visible. It is also just more fun to see the activities of wild birds ''close up.'' Identifying birds—that is, knowing their common or scientific names when you see them—is not necessary to the enjoyment of watching them. Observe birds as part of your natural surroundings, and see how they interact with their environment. This is a rewarding and educational experience, even if you never learn to distinguish a yellow warbler from a yellow-billed cuckoo.

An Historical Perspective

Good binoculars were not developed until early in the 20th century. Until these became available, if a person

Just watching birds flying past or perched nearby provides countless people with enjoyment. Learning to identify birds often results in a life long hobby.

wanted to inspect the field markings of a bird, he or she had to hold the bird in his hand. This meant that people usually shot birds and looked at the dead specimens. A shotgun and a bird dog were considered essential equipment for the pursuit of knowledge about birds.

Field guides for birdwatchers of that period overflowed with detail about bill and wing lengths, and the colors of specific feathers which are not even visible on live perching or flying birds. There was little useful information in these guides about calls and songs (dead birds being remarkably silent!), or about "field marks," the distinguishing characteristics that are most readily observed on live, active birds. The first really good guide to field marks was published in the 1930s. Since then, the popularity of birdwatching has grown steadily.

Now, of course, nearly all wild birds are protected by law. People realize the necessity of conserving and protecting wild lands and wild creatures. Field guides and other instructive books about birds are written exclusively for sight identification, for birdwatchers at all levels of expertise.

Field Guides and Bird Books

Many authors and bird-interest organizations have published field guides about birds. These books are intended for use by people who want the details of color and plumage patterns, and all the little "tricks" of identifying each species. They are made small enough that you can carry them with you on bird walks, for quick reference while you have the bird in sight, or at least soon after it escapes from view. Of course, with this size limitation, most field guides cannot provide much information about the natural history of birds.

Arrangement of information varies among the different books. Some list birds in strict taxonomic order. Others group them by conspicuous coloring, or by habitat type. Picturing each species is accomplished by photographs in some, color or line drawings in others. Illustrations may accompany species descriptions, or be in a separate section. Many field guides also provide maps showing the geographic locations of each species at different times of the year. An individual guide may include only one state, or half of the country. Or it may cover all of North America.

Listed below are some of the better known bird field guides that are commerically available. You may wish to compare them and decide which is easiest for you to use or most informative along the lines of your interest in birdwatching.

Birds of North America: A Guide to Field Identification, by C. S. Robbins, B. Bruun, and H. S. Zim, illustrated by Arthur Singer.

A Field Guide to the Birds, by Roger Tory Peterson.

The Audubon Society Field Guide to North American Birds, Eastern Edition, by John Bull and John Farrand, Jr.

Field Guide to the Birds of North America, published by the National Geographic Society.

Many other books about birds give far more information than the field guides, because their format is not limited to field use. The following publications may be interesting to bird enthusiasts. Some of these books also are quite beautiful. In writing this book, we drew heavily from the comprehensive works of Terres and Welty.

The Audubon Society Encyclopedia of North American Birds, by John K. Terres.

The Life of Birds, by Joel Carl Welty.

Ducks, Geese, and Swans of North America, by Frank C. Bellrose.

Song and Garden Birds of North America, published by the National Geographic Society.

Water, Prey, and Game Birds of North America, published by the National Geographic Society.

The Habitat Guide to Birding, by Thomas P. McElroy, Jr.

Birds of North America: A Personal Selection, by Eliot Porter.

Birds of Pennsylvania, by Merrill Wood.

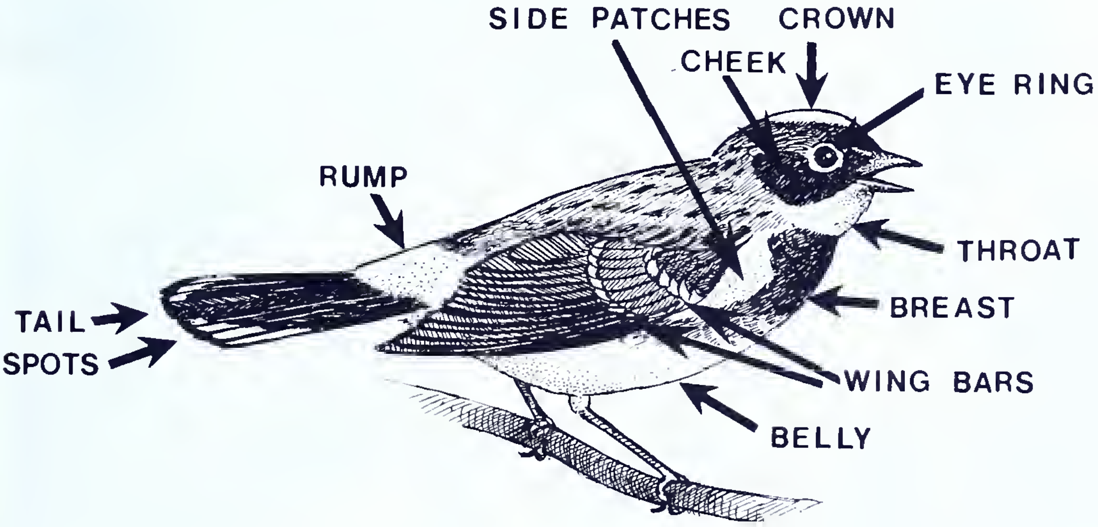
What to Notice About a Bird

When you encounter a bird which you would like to identify, certain characteristics of its appearance and behavior will help you to determine its species and common name. The order in which these characteristics are noted is not critical. It is important to remember that *combinations* of these features are distinctive. Just color, or any other single feature, usually is not.

Color and Field Marks

Most people notice the color of a bird first. But color, of course, is not unique. For example, many birds are black, gray, and white, including such diverse creatures as buffleheads, mockingbirds, chickadees, and ring-billed gulls. Many birds are streaked brown; these include females and juveniles of a great many warblers, finches, and sparrows, as well as many adult birds, such as bitterns, brown thrashers, and bobwhites, to name a few. For positive identification, something more specific than color is needed.

Field marks include the physical markings which should be visible on a bird during its normal activities. Body shape and bill shape are obvious characteristics for field identification. More specific examples of field markings include patches of colored feathers that flash on wings or rump as the bird flies, bands along or across the tail,



Color is not as important a characteristic for accurate bird identification as many aspiring birdwatchers think. More important is thorough familiarization with the bird's body parts where key distinctive characteristics are most evident.

crest on the head, light eye rings, prominent wing bars, and other eye-catching patches of color. Recognizing these distinctions will aid in identifying an individual bird.

Silhouette

A bird's shape, or the silhouette you see as it flies or perches, can be distinctive. Is it broad-bodied, like a robin? Are its wings long and angular, as are a gulls? Does it have a swallow's forked tail? Is its flight characterized by the extended head and rapid wingbeats of a duck? Noting silhouette, along with other features, can be useful to those who try to identify birds which are flying overhead, or are only visible through the window of a moving vehicle.

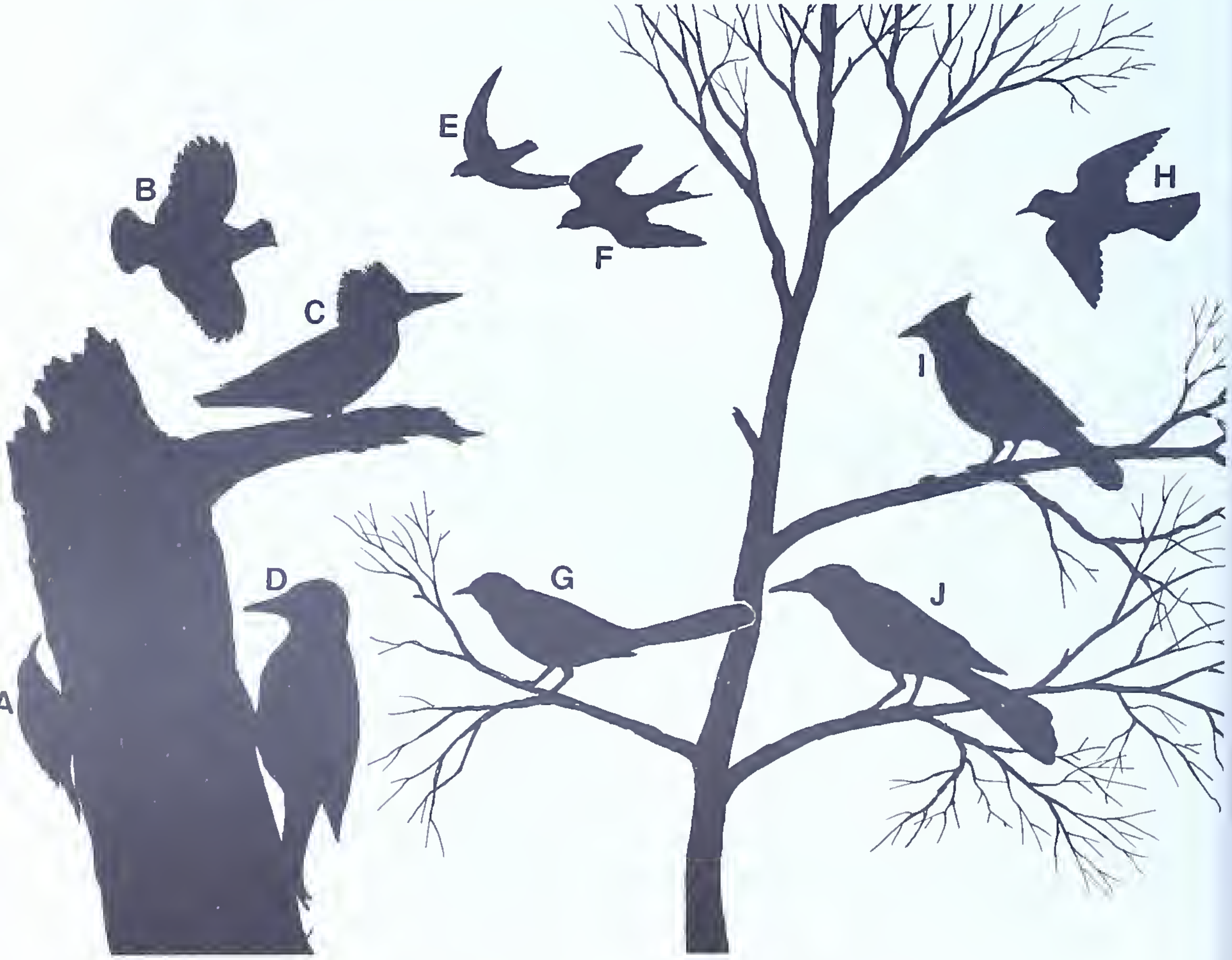
Relative Size

Many people, even before they become interested in learning more about birds, are already familiar with several common species. When trying to identify an unfamiliar bird, mentally compare the one you see with those you already know. Is it smaller than a crow? Slimmer than a robin? Longer than a house sparrow? Noting the relative size of a bird may be helpful to your efforts at identification.

Habitat

Certain groups of birds live in different types of habitat, to fulfill their different requirements. Notice where the bird is when you see it. A bird high

For an experienced birdwatcher, silhouettes alone are often all that's needed for identification. Some common species readily recognized by their silhouettes are: (A) brown creeper; (B) common bobwhite; (C) belted kingfisher; (D) common flicker; (E) chimney swift; (F) barn swallow; (G) northern mockingbird; (H) eastern kingbird; (I) bluejay and (J) common grackle.



in the treetops along a forest trail almost certainly is not a meadowlark. Some birds, such as pine siskins, are seldom far from evergreens. Juncos and towhees, because they usually forage on the ground, probably will not be perched in the open on powerlines. Water birds shun the treetops; most woodpeckers avoid open fields. Individuals of each species usually remain in areas of the type of habitat that sustains them. Therefore, noting the environment in which you see a bird will help to limit the number of species to which it could possibly belong.

The final chapter in this book describes six major types of habitat in Pennsylvania. Some notable aspects of behavior and natural history of many of the common species of birds are described in relation to each habitat where they may be found.

Behavior

As essential as observing where a bird is, is noting what it is doing. How does it interact with its environment? Does it cling to the bark of large trees, like a nuthatch? Does it hop and scratch along the ground like a towhee? Is it hiding in the treetops, as does a tanager, visible only as it flits between branches? Does it hover, like a hummingbird, or soar like a vulture? Or, like a chipping sparrow, does it fly short distances from one shrub to another? Some birds, such as plovers and sandpipers, run nimbly along the shore. Diving ducks walk only slowly and awkwardly, and usually take off and land on water. Swallows will swoop and dive to pick insects out of the air, while finches pick weed seeds in abandoned fields.

Observations such as these, of a bird interacting with its surroundings, can clarify distinctions among species. Knowing the combination of where a bird is and what it is doing gives you a powerful tool for identification, as well as an enjoyable lesson in natural history.

Time and Season

Birds fix upon different times of day to be active or vocal. Certain birds, notably nighthawks and swifts, come alive at the end of the day. Some birds whose names suggest a preference for the dark, like evening grosbeaks and vesper sparrows, may actually sing any time. Other birds' activities peak as the red rays of sunlight take a first slanting look at the countryside. If dawn is not your time, you will seldom see them. Because of these differences, the peak of daily activity for some species may aid your efforts at identification.

An especially useful means of paring down the list of possibilities, as you try to identify an unknown bird, is noting the season of the year it spends in Pennsylvania. The cold winds of autumn precipitate major changes in birdlife. Some birds which raise their young in the northern reaches of the continent may move into Pennsylvania for the winter. Likewise many birds that find this climate appropriate to their nesting needs depart southward for warmer winter environs.

You may choose to launch your efforts as an amateur birdwatcher during cold weather. Silent snowy landscapes, seemingly devoid of wildlife, may secretly be filled with birds during their quiet months. As you hike or ski along leafless trails, small mixed flocks of wintering woodland birds will chatteringly appear, as if by magic. Foraging onward, they blend again into the solitude. Well-stocked feeding stations in your backyard also can focus the activities of otherwise reclusive and very cold birds. But the number of individual species wintering here is not prohibitive, and it makes a good place to start learning names and habits.

Any of several hundred species of birds may fly over this region during spring and fall migration. Although they commonly fly at night, flocks of migrating songbirds or water birds may stop for a few days of resting and feeding. Unusually cold spring rains may drive huge numbers of migrating warblers out of the sky and down to the protective lower branches of tall trees. You might awaken some rainy May morning to find your backyard woods festooned with warblers. Their suburban visits are fleeting, and thereby provide special opportunities for you to extend your repertoire.

During the breeding season and for much of the summer, more birds are conspicuous in their behavior, belligerently parading their finest plumage and voice. Times of high visibility also allow your birding abilities to grow. The bottom line is: all seasons are good for birdwatching!

Bird Songs and Calls

The songs of birds may seem to be endlessly complex, unpredictable morasses of melodic noise to amateur bird enthusiasts. But with surprisingly little effort, many people discover that the randomness begins to resolve itself into patterns; that what was once confusing is really filled with familiar strains.

Some birds are quite helpful at sorting out confusing songs. They sing their own names, at least part of the time. Spring evenings in forest margins may be filled with the sound "whip-poor-will." Chickadees, phoebes, and bobwhites also are considered by many to say their names. And many other birds have songs that are equally distinctive.

Calls and songs of most North American birds have been recorded by the Laboratory of Ornithology at Cornell University. Records and tapes of bird songs are available for purchase from many organizations concerned with wildlife, and are in the collections of many public libraries. These recordings have helped many people learn to distinguish among bird songs.

Notable aspects of distinctive bird songs are described in field guides. Some books even provide sonograms, or sound pictures, showing the recognizable patterns of a song. In conjunction with the other attributes of field marks, habitat, and behavior, bird songs certainly should be noted and learned for both enjoyment and identification.

Fostering Your Interest in Birds: Wildlife Organizations

When most people think of "bird clubs," they think first of the National Audubon Society. The Audubon Society is far more than a bird club. It is one of the oldest and largest conservation organizations in the world. The interests of its many thousands of members have long since extended beyond birdwatching, now emphasizing an understanding of the interactions among many aspects of the natural world. Hundreds of local chapters of the Audubon Society are active nationwide. Many have periodic meetings, field trips, and hikes to further people's interest in and knowledge of wild birds and other animals. *Audubon,* the award-winning periodical of the Audubon Society, and other Society publications, also encourage interest in birds and beasts.

The National Wildlife Federation is another large national organization concerned with knowledge and conservation of wildlife. Their publications are written for non-science audiences, and they provide beautiful educational materials. Magazines published periodically by both of these organizations are available in most public libraries, and provide information about membership. In addition, many communities have bird clubs not directly affiliated with either of these national groups. Again, your public library may be a source of information about these opportunities to meet people in your community who know about birds.

SIX TYPES OF HABITAT AND THE BIRDS LIVING IN THEM

The habitat of a bird is the place where it lives. Each habitat is the home of a different combination of plants and animals, that combination being controlled by factors such as soil type, land form, temperature, rainfall, and human-caused changes. A bird's habitat supplies all the requirements for its life: for feeding, singing, mating, and safely raising young; for all features of its behavior. Thus the number and variety of birds living in any area is determined by the characteristics of the habitat in that area.

Pennsylvania can be divided into six broad habitat types on the basis of predominant plant groups, human influence, and the presence or absence of water. A convenient way to become familiar with the birds of Pennsylvania is to learn which birds live in which habitat. The birds flitting above your head through a hemlock forest on a mountainside are unlikely to be the same species as those you see stealing corn in farm fields, or splashing in the birdbath in your garden. The hemlock forest represents one habitat type, where one plant group dominates. Fields and suburban gardens are in another type, where the influence of man is an important feature. Each habitat type provides different opportunities for a different group of birds.

Some species, of course, can be seen in more than one habitat type. This is especially true in areas where small patches of forest and farm fields adjoin suburban residences, golf courses, or marshes, interfingering several types of habitat within a small area.

In the following chapters, the more common species of birds are described in relation to the habitat in which they are most likely to be observed in Pennsylvania.

Fields, Suburban Gardens, and City Parks

A fairly large number of bird species is likely to be seen in areas frequently visited by people. These areas include your backyard, the neighborhood park, college campuses, golf courses, farming areas, even airports. Moderate disturbance by man will not deter some birds from nesting and feeding in these places. In fact, many native North American birds are well adapted to the environs of farms and suburbs. Very few species, however, will thrive in such heavily disturbed areas as densely populated towns and cities, high-rise apartment complexes, and shopping centers. Birds which have become adapted to our central cities include house sparrows, starlings, and rock

doves (pigeons). All of these are non-native birds. Brown-headed cowbirds, common grackles, and to a certain extent, robins, also are tolerant of buildings and noise. But most of the birds in the list below concentrate their activities in areas with less traffic. They prefer areas containing such features as shrubs, lawns, gardens, hedges, fences, barns, nesting boxes, and feeding stations.

Rough-legged Hawk

Some individuals of this species of large soaring hawk nest in Siberia; others raise their offspring in the Canadian tundra. And some of these latter individuals spend the cold season in Pennsylvania, which for them constitutes flying south for the winter.

Rough-legged hawks, so named because of their feathered lower limbs, hunt in the open country of farm fields and pastures. Despite their large size (20 to 24 inches long with a 48 to 54 inch wingspan), they have relatively small feet. This limits the size of prey they can catch, so they hunt and eat mostly small rodents and, surprisingly, large caterpillars and grasshoppers when they are available. Other hawks of similar size, such as the western ferruginous hawk, prey on rabbits and larger animals.

When hunting, a rough-leg may hover in one place like the much smaller kestrel, or flap and glide low over the fields like a harrier. It also may hunt from a high perch, watching from atop a fencepost or snag. Trusting keen eyesight, it can detect the smallest hint of a mouse rustling in the grass, or a mole emerging from its run beneath the snow.

American Kestrel

This is the smallest and most common raptor, or bird of prey, in North America. It is commonly called "sparrow hawk," a name that is wrong on two counts — kestrels eat many things besides sparrows, and they aren't hawks, they are falcons. Hawks and falcons are outwardly similar, having hooked beaks and taloned feet, but there are major differences which place them in separate families of birds.

Kestrels have adapted well to life with humans. Favored hunting sites are often along roadways, where they perch conspicuously on powerlines. They are brightly colored and easy to recognize. Morning and late afternoon are their busiest hunting times. On pointed wings, the kestrel swoops down from a utility pole, flying over the fields with alternating short glides and quick wingbeats. When prey is sighted, the kestrel may hover briefly over it, then dive to the ground, wings partly folded, to grasp a large grasshopper or small rodent with its feet. Dinner is then transported to a fencepost perch, or back to the nesting cavity in the proper season, and eaten in small bites.

The American kestrel, commonly called "sparrow hawk," is Pennsylvania's most abundant bird of prey. Kestrels are often seen along highways, either perched on a powerline or hovering above the right of way.

Great blue heron, by Ned Smith. Great blue herons can be found around small farm ponds, large lakes, or along streams and rivers where they feed on fish, reptiles, amphibians and, occasionally, on small mammals.

Greater yellowlegs, by Ned Smith. This relatively large shore bird is a common migrant, but only an occasional winter and summer resident.

Canada goose, by Ned Smith. This large bird has adapted to the many water impoundments constructed around the state, and has even taken up residence in some of our larger cities.

Ring-necked pheasant, by Ned Smith. The raucous cackling and thrashing wings of an old ringneck breaking from cover have left many a hunter helpless and awestruck, gun forgotten, until this big gaudy bird is out of range.

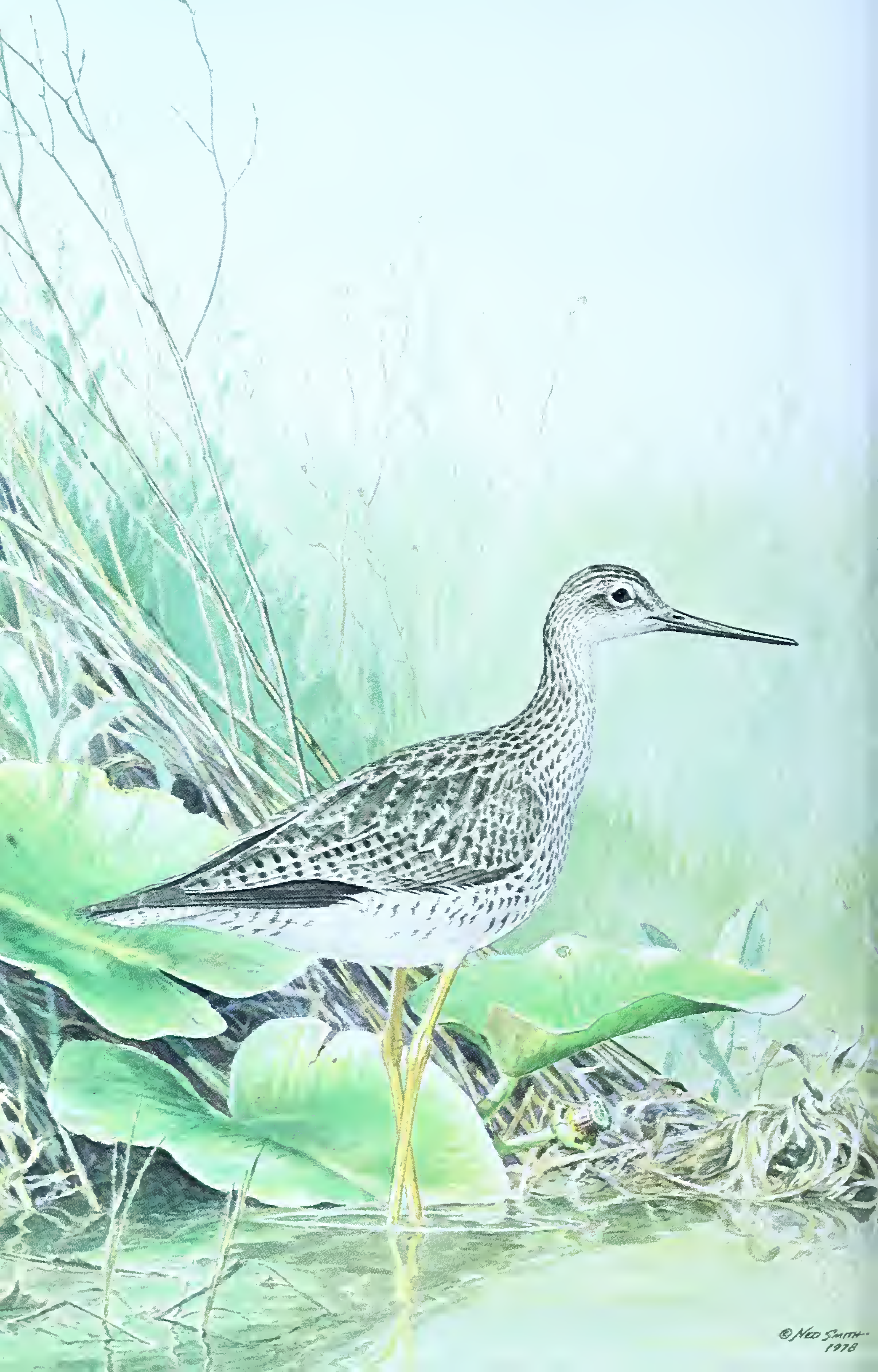
Mourning doves, by Ned Smith. Mourning doves are an abundant bird around the farm and they have adapted well to suburbs as well.

Bobwhite, by Ned Smith. A bird of farmland and abandoned fields, the range of the bobwhite in Pennsylvania is limited to areas with the mildest winters.

Wild turkey, by Ned Smith. Many hunters consider the wild turkey the ultimate trophy because its keen senses make bagging one of these birds an extremely challenging proposition.

Ruffed grouse, by Ned Smith. This, our state bird, is a common resident of brushy second-growth forests throughout the state.

ED SMITH
1981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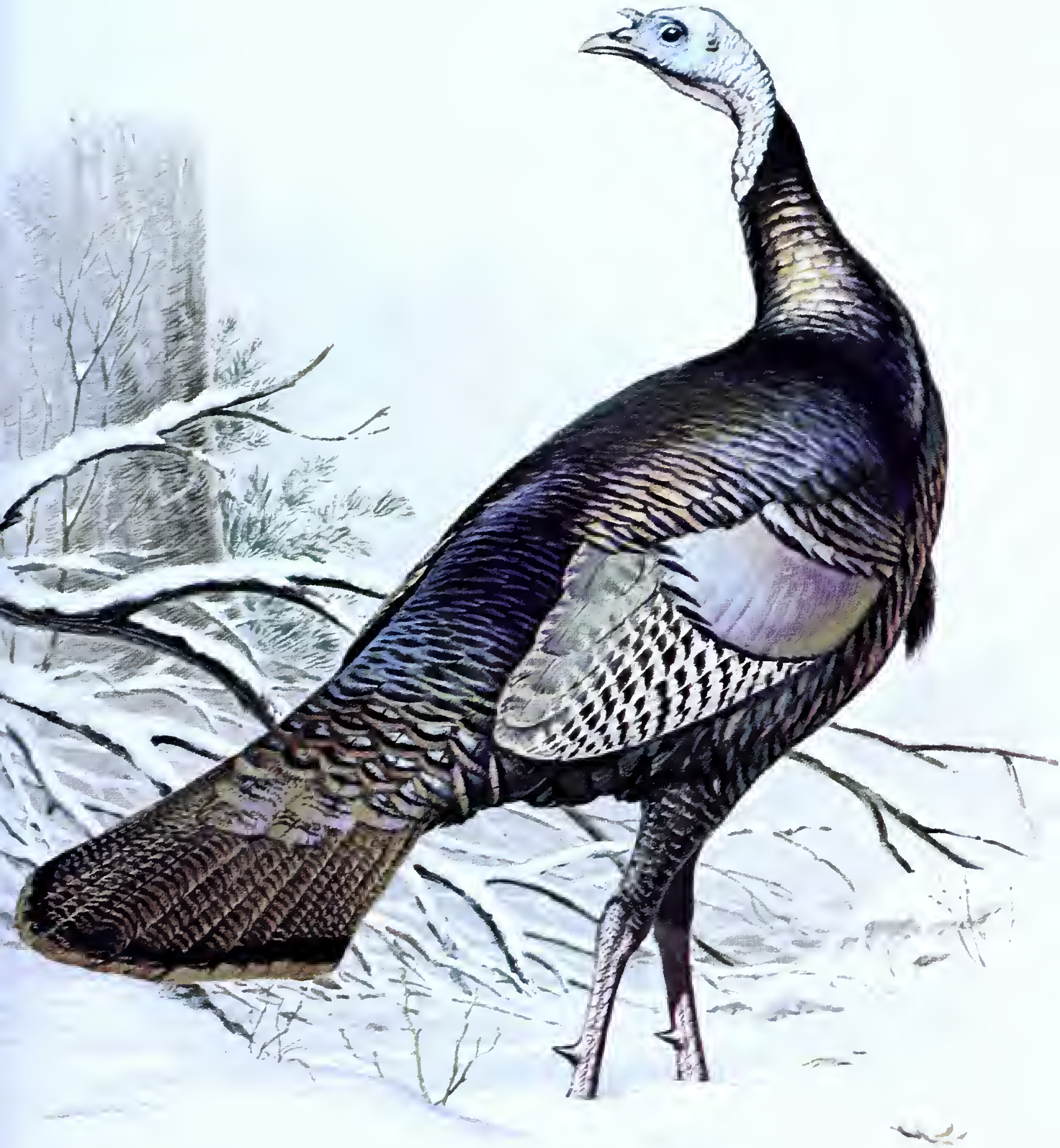

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In some places, kestrels have opted for urban life. Holes under gables and in decorative brickwork serve as nest cavities. And house sparrows, thriving in the same habitat, are a constant supply of food.

Northern Bobwhite

To see a covey of bobwhites is one of the special privileges of Pennsylvania country life. Bobwhites, known familiarly as "partridges" or "quail," reside all through the year in the thickets adjoining farm fields and pastures. The covey is their winter group. Only in the northern counties and high elevations of Pennsylvania is the weather too harsh for winter residency. Parents and their grown chicks are the founders of the covey. Other individuals and pairs may join them in the fall. They have greater safety in numbers.

Through cold snowy nights, the birds hide together in tangled brush and weeds. They form a circle, with their heads pointing outward and their bodies touching for warmth. A warning cry from any individual launches all the birds outward in different directions, in an explosion of wingbeats. The invader may be too startled to continue pursuit. By morning the "all clear" is sounded, and the covey reassembles. Their daylight hours are filled with foraging for seeds and dried berries exposed above the snow.

In spring, the birds pair off for mating and nesting. After a brief period of mutual belligerence, the pairs are able to live fairly close together in peace. Both parents work on nest construction. A large shallow depression is scratched out on the ground, then lined and possibly roofed over with grasses. This cover helps conceal 15 or more bright white eggs, which would otherwise be dangerously conspicuous. The dull brown streaked coloring of the parents also helps the nest site blend unobtrusively into its surroundings.

Young bobwhites hatch after about three weeks of incubation. From the first day, they are able to move about on their own, walking through fields and hedgerows with their parents. Bobwhites are also commercially raised in Pennsylvania on private game farms, for release on regulated shooting grounds and for use at dog training trials.

Ring-necked Pheasant

Among the species of wildlife which were imported into the United States, the ring-necked pheasant stands out as a success story. Success is measured not just by establishment of resident populations. Some other imported species, such as the starling, become pests when their numbers became too great. Pheasants apparently have not displaced any native American birds. They have in fact become a favorite species of game bird.

Ring-necked pheasants are native to Asia. Centuries ago they were brought to the Mediterranean region, and taken from there to England with Caesar's troops. Early European settlers in

The bobwhite is a common farmland game bird in the South, and it may be encountered in suitable habitat throughout Pennsylvania, but it is most likely to be found in our southern agricultural counties.

North America brought pheasants to the east coast with little success. In the 1880s, pheasants were imported directly from China to Oregon. From these birds, a large breeding population established itself. Ten years later, pheasants were abundant enough that a hunting season was proclaimed. Many states then began raising pheasants on game farms, so that sportsmen in other regions of the country could enjoy pheasant hunting.

Pennsylvania has hosted a thriving population of ring-necked pheasants since at least 1915. The Game Commission raises and releases pheasants to augment stocks for hunting, but "wild" populations exist in the commonwealth year-round.

Male and female birds spend the winter in separate flocks. Pairing begins again in early spring. Pairs of pheasants have wandered through our backyard in March. Open fields and farm fencerows provide ideal habitat. Waste grain and seeds for food are plentiful, as are grassy areas for the females to incubate their large clutches.

The ring-necked pheasant was successfully introduced to this continent from the Orient around the turn of the century, and has since become a popular bird among hunters and nonhunters alike.

Young pheasants are able to run about with their mother and scratch for food from the day they hatch. The female pheasant looks after them until they are fully grown. She may try to protect them from predators by feigning injury, as does the killdeer. Young pheasants are adult size just in time for the fall hunting season.

Killdeer

The killdeer is one of the most common members of the plover family. Most of their plover cousins are shorebirds. The killdeer chooses instead farm fields, pastures, and old roadways for nesting sites, and commonly is seen in upland habitat. Small flocks of killdeer may run along the ground following a plow. Freshly turned earth is resplendent with grubs and bugs, providing easy meals. With its loud song, the killdeer is thought to cry its name.

Killdeer don't build much of a nest. They lay their brown-speckled eggs in a shallow depression, possibly lined with small stones or dried grass. The nest and eggs blend into the ground, well camouflaged.

The so-called broken-wing act of the parent killdeer is well known. Humans or predators approaching too close to the nest send the panicked parent into noisy, awkward flapping. It flies in circles, and flops on the ground as if injured. Whatever the cause of this behavior, the effect is to draw the attention of the invader away from eggs or young. The parent killdeer apparently recognizes grazing animals as non-threatening. Remaining on the nest, the killdeer will scold vociferously, and possibly run at the face of an intruding cow, to startle it into moving away.

Rock Dove

Belonging to the same family as mourning doves, rock doves are known to most people as "pigeons." This familiar inhabitant of city parks and church towers has been domesticated for thousands of years. It was brought to North America by early European settlers. The act of importing them was not remarkable, indeed hardly noticed, so familiar were people with pigeons.

Homing pigeons, the heroes of wartime message service, also are rock doves. News of Caesar's conquests, and of Napoleon's defeat, travelled home with pigeons. They were used for mail service in the 16th century. In modern cities, pigeons carry tiny but important items, such as medical samples, far above the congested streets and in less time. Studying the homing activities of pigeons is allowing scientists to learn how birds navigate.

Unfortunately, there can be too much of a good thing. Large populations of roosting pigeons deposit large quantities of droppings on building fronts and walkways. In some cities, just cleaning up after them is expensive and time-consuming. The droppings may also contain viruses and fungi that are infectious to humans.

Mourning Dove

Your backyard birdbath or feeding station probably will attract mourning doves. These large, soft-brown birds nest in almost every state. For nests, they build loose platforms of twigs, up to 25 feet or more above the ground. In our neighborhood, they choose surprisingly visible locations in oak trees, piling masses of twigs at the junction of branch and trunk. During courtship, a female dove walks about on the ground, followed closely by the interested male. A male puffs out his neck to flaunt his suitability as a mate. The doves' low-pitched cooing song is familiar to many people.

Farming and other encroachment by man has favored the mourning dove. The diet of these birds is largely weed seeds and grain. These food items seem to be almost everywhere people are — thus the reason mourning doves are so common. In Pennsylvania and many other states, they are also a gamebird.

Barn Owl

A preference for nocturnal activity generally makes owls hard to find. The barn owl, however, as its name suggests, inhabits barns, abandoned buildings, and caves, where it roosts during the day. Knowing where to look may help you find them.

At night, barn owls go forth over the fields, like huge pale moths with noiseless wings. Small rodents and other creatures of the dark are in jeopardy. The large, silent owl plunges feet-first, to grab a mouse or shrew, or perhaps a small bird. Its hearing alone is adequate for locating its prey, even in total darkness.

Young barn owls hatch in almost any month. A single nest may include both eggs and young, due to different laying and hatching times. Barn owls apparently nest with the same mate year after year, finding a new partner only when death takes the first.

One common name for barn owls is "monkey owl." This is a reference to their peculiar monkey-like countenances, provided by their uniquely feathered oval faces.

Common Nighthawk

The nighthawk is not really a hawk. The name comes from the resemblance of its flight pattern to that of hawks, and from its "hawking" for insects in the air. Their mouths open the whole width of their heads, as they sweep flying ants and moths from the air. They drink the same way, skimming the surface of ponds over which they fly.

Nighthawks are common over towns and farms, where they are most often seen at dawn and dusk. Wheeling overhead, they emit a nasal "peent" call. During courtship, the males make sudden high-speed dives. Air vibrating through their primary wing feathers causes a muffled booming sound, often audible to listeners on the ground. Warm summer evenings are good times to listen for the peculiar nighthawk noises.

Nighthawks have adapted fairly well to humanity. Usually ground-nesting birds, they may also choose the flat roof of a building for raising their family. Roof-nesting frees the eggs and young from most predators, but introduces a hazard of civilization. On hot summer days, the eggs can become mired in melted roofing tar!

Chimney swifts are common in all of Pennsylvania's cities. They are most noticeable in early mornings and evenings when they can be seen spiraling overhead.

Chimney Swift

Adaptation to prolonged, seemingly effortless flight is the special gift of the swifts. Chimney swifts spend most of their lives in the air. Throughout spring, summer, and fall, flocks of swifts soar and spiral above fields and towns. They feed, drink, copulate, gather nesting material—all without landing. Their small feet, with four toes pointing forward, are uniquely adapted to their clinging style of roosting. Nightfall brings the flock in to a large tree cavity or chimney. They grasp the walls, overlapping in a living drapery of swift bodies.

Swifts attach their nests to the insides of barns or chimneys. They use only twigs and saliva as building materials. Incubating the young, a task shared by both parents, is one of their few times of prolonged quietude. The young remain in the nest for up to three weeks. Feeding them usually requires the parents to fly day and night, snatching insects from the air.

The long curved wings of swifts resemble those of swallows or falcons. Swifts use differential wing movement to steer, their tails being too short to be useful rudders. The resultant flight pattern, of soaring interrupted by quick, irregular wingbeats, is characteristic of these unusual birds.

Ruby-throated Hummingbird

Smallest and possibly most intriguing of birds in Pennsylvania is the ruby-throated hummingbird. During the summer, when you see a tiny, almost insect-like bird hovering and flitting among flowering plants and shrubs, you have seen this hummer — or at least its body. The wings beat so fast that they are invisible. And during this incredible output of energy, the hummingbird can fly short bursts at up to 60 miles per hour. Flight is possible in every direction, including backwards. Yet all the while their wings are busy, they can hold their bodies quite still.

When active, this brightly colored three-and-a-half-inch bird burns energy at a rate ten times that of a human running nine miles an hour. Hummingbirds must eat every 10 to 15 minutes. They are attracted to red flowers, the nectar of which is their main source of food. They will also eat small insects. To survive the night, hummingbirds sometimes become torpid, that is, achieve a quiet condition which requires far less energy than normal sleep.

Walnut-size hummingbird nests are built of tiny plant fibers, secured with spider web, and hold two pea-size eggs. The female hummingbird feeds her young by inserting her needle-like bill into the nestlings' throats, to what looks like a damaging depth. But far from injuring her offspring, she is pumping them full of flower nectar.

Perhaps the most unbelievable activity of these tiny beautiful birds is their autumn migration. The flight from their nesting range in the eastern U.S. to warmer areas for winter may be 2,000 miles long, much of it over ocean. An amazing feat for a bird the length of a man's thumb.

Northern Flicker

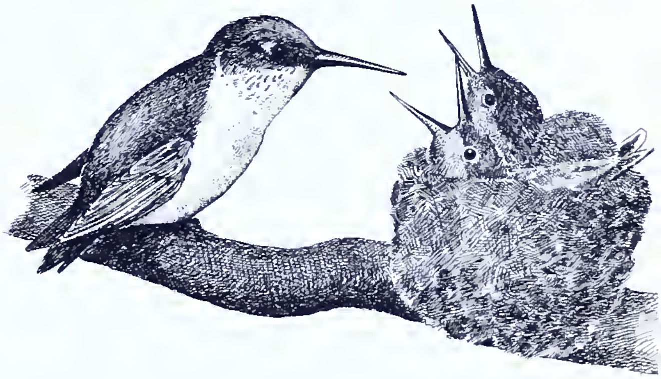
This woodpecker of forested suburbs and parklands spends much of its time on the ground. Ants comprise a large percentage of the diet of northern flickers. Ants live in and on the ground, so that is where the flickers must feed. Ornamental and fruit-bearing shrubs and trees, such as raspberry, serviceberry, and grape, also provide favored food items. Their habit of feeding in your lawn and garden makes flickers fairly easy to recognize. A large white rump patch, visible during their low, undulating flight, is another key to recognition.

Flickers only rarely spend the winter in Pennsylvania. They commonly appear in early spring, announcing their return with gusto. Messages of mating availability and territorial occupation are sent by drumming with their bills on any resonant object. Rural mailboxes and roof gutters are favorites. Competition for mates may involve two females vying for the favors of a male with real estate; or it may take place in the accustomed manner, with the males fighting over one female bird.

Like other woodpeckers, flickers nest in holes which they excavate in living or dead trees. Starlings, unable to create cavities for themselves, compete fiercely with flickers for nesting sites. Unfortunately, the starlings frequently win. They brazenly usurped a flicker nesting cavity in a live maple tree in our neighbor's backyard. The persistent flickers hollowed out another home in another maple, and successfully fledged their offspring. That tree was toppled during a winter storm. Undaunted, the flickers now nest on an undeveloped forested lot across the road.

The flickers of the eastern U.S. were once called yellow-shafted flickers. The feathers on the undersides of their wings are distinctively bright golden yellow. These birds were thought to be a different species than the red-shafted flickers of the West. Ornithologists have learned that these two races of flickers interbreed freely where their ranges overlap. Some strangely colored hybrids result from their mingling, but they clearly belong to a single species, now known nationwide as northern flickers.

Ruby-throated hummingbirds are the smallest birds in the state. Their nests are only an inch or so in diameter with room for only two pea-size eggs.



Red-headed Woodpecker

Open parkland with scattered patches of large deciduous trees and snags attracts red-headed woodpeckers. Old orchards and the woody margins of golf courses are ideal. These birds need the trees for their nesting cavities. And the open grassland between is filled with grasshoppers and other flying insects, the mainstay of this woodpecker's summer food supply.

Such areas of perfect habitat for red-headed woodpeckers are disminished as the large trees are felled for commercial use and land development. Competition from starlings, which take over nesting cavities, has caused nesting sites to become a severely limiting factor.

The red-headed woodpecker is the only resident woodpecker in Pennsylvania that has an entirely red head. The combination of large white wing patches, white breast, dark back, red head and the absence of streaks or stripes is unique to this beautiful bird. Others, such as downy, hairy, and pileated woodpeckers, have patches or crests of red, while red-bellied woodpeckers are red only from the top of the head to the back of the neck.

Eastern Kingbird and Eastern Phoebe

A family of birds known as flycatchers is represented in Pennsylvania's fields and farms by the eastern kingbird and eastern phoebe (pronounced "feebee"). The drab, unmemorable coloring of these small birds contrasts markedly with their aggressive behavior. To protect their nests, kingbirds rely on their own vigilance and endless willingness to attack intruders. Camouflage is unnecessary. Small groups of kingbirds will chase and harry hawks and crows many times larger than they, if their living space has been invaded.

Both kingbirds and the less aggressive eastern phoebe "hawk" for insects. They consume huge quantities of wasps, moths, and ants, frequently by plucking them from midair. Phoebes often nest in or on the outbuildings and unused machinery of farms, where they are welcome as natural controls of insect pests. The phoebe is thought to sing its name.

Horned Lark

Horned larks are birds of open spaces. They can be seen year-round, flying over fields and pastures. Freshly spread manure on snowy fields often attract them, as they walk or run — never hop — over the ground.

Male horned larks are renowned for their aerial battles for dominance in March and April. The victors treat their mates to spectacular spiralling nuptial flights. These birds are among the first each year to nest, on the ground before fields are plowed. Their coloring is not showy, but their courtship behavior makes them highly visibile.

Barn Swallow and Cliff Swallow

Many Pennsylvania farms host breeding colonies of barn or cliff swallows. These two species are known for their preference for nesting inside barns and under the eaves of old buildings. They will, in fact, nest together in large groups of mud-and-straw nests, built cup-shaped by the barn swallows, long-necked and narrow by cliff swallows. Interbreeding is very rare, each bird possibly able to distinguish its own kind by distinctive song and call notes. Nesting colonies also may be found under bridges or on natural cliffs and cutbanks.

Swallows consume huge quantities of flying insects. Thus they are often welcome on the farm where they nest. Their small bills but large gaping mouths are well suited to catching insects in flight. Long, slender wings, and weak and diminutive legs and feet are tailored to their airborne existence. They visit the ground only to gather mouthfuls of mud for their expert masonry. However, their feet are adequate for perching. Large flocks of swallows will perch together, carefully and evenly spaced along powerlines, as they prepare for their fall migration to warmer climates.

Swallows are true harbingers of spring, returning each year to the same area only when the weather is warm enough to bring out insects. Massive starvation can result from an unexpected cold snap.

Both barn and cliff swallows have dark backs and buffy to orange underparts. They are best distinguished in flight by the shapes of their tails. Cliff swallows have square tails while those of barn swallows are deeply forked.

Purple Martin

The purple martin is actually a large, dark swallow. Because martins prefer flies, mosquitoes, and wasps as food, nesting colonies usually are welcomed upon their return to back gardens and farmyards. Martins are aggressive birds, and will chase crows and other larger birds away from the vicinity of their nests.

Martin houses, constructed especially for them, provide nesting opportunities which these birds seem to consider ideal. In fact, martins have been nesting in structures provided by humans for hundreds of years. The relationship began with American Indians hanging groups of hollowed-out gourds from poles. Martins still nest in gourds in the southern states. Over much of their range, martins have abandoned more natural nesting cavities, to become closely associated with man.

In late summer, many colonies join together, forming huge flocks which may number ten of thousands of birds, as they prepare for fall migration.

Blue Jay

The beautifully colored blue jay demands attention. Jays are one of the larger species readily attracted to backyard feeding stations in winter. Small flocks announce their presence loudly, and with distinctive color and crest, they are easy to observe and identify. They will accompany people through the woods, emitting a warning cry that is the bane of deer hunters.

Blue jays become quieter and more solitary when nesting. Once a forest bird, the intelligent jay has been able to adapt to and thrive on the changes caused by human habitation. They still build their nests in beech or oak woods, or in an opportune conifer in wooded gardens. Summer visits to your backyard will be increased if you provide a bird bath. But be prepared to fill it again when the jays depart!

The stout and strong bill of the blue jay, like those of other members of the crow family, permits them to eat nearly anything available. They can crack open acorns, or catch and eat insects and small animals.

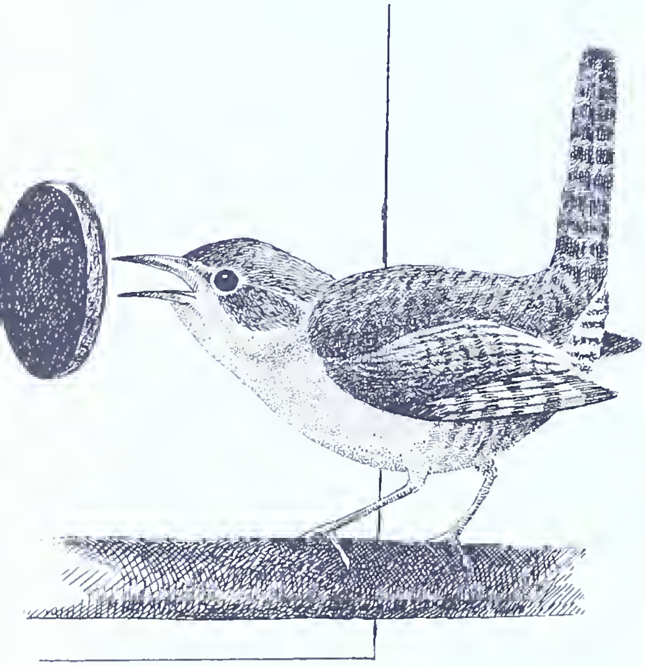
American Crow

Members of the crow family are considered by some experts to be the most intelligent birds. Captive crows have been taught to count up to four, solve puzzles, and mimic the sounds of other animals including human speech.

Crows are possibly the best known birds of farmland and roadsides. They

Purple martins have always been welcomed by man as they consume vast numbers of mosquitoes, gnats and other insects; they have also adapted to the apartment-style nest boxes designed especially for them.
Leonard Lee Rue

are reputed to be agricultural pests, but usually cause large-scale damage only in their huge wintering flocks, and only locally. During the breeding season, solitary pairs build large, strong nests high up in isolated or forest trees. Crows are truly omnivorous, eating anything that is handy. Motorists frequently see crows eating road-killed animals, but seldom hit them. Crows are clever and quick enough to fly off just in time.



The relatively nondescript house wren is most easily identified by its habit of cocking its tail straight up. This wren readily accepts man-made nesting boxes placed in suburban yards.

Similar in size to many hawks, crows in flight can be distinguished by their steady wingbeats, with little gliding or soaring. The large flocks of fall and winter split up and search widely for food during the day. But toward evening, each crow heads directly for the roost; hence the phrase "as the crow flies" for the straight-line distance between two geographic points.

House Wren

Although its brown coloring may not be impressive, the house wren is a small energetic bird that is hard to overlook. In the spring, house wrens enthusiastically invade parks, gardens, and deciduous wood margins, to begin nesting and eating insects. A crevice or hole in a tree, fence, or building provides a nesting site if no nest box is available. This is the plainest wren, lacking distinctive stripes or streaks. Its tail cocked straight up or bobbing rapidly above its back tells you it is a wren. Its song is a loud musical chuckle, surprisingly boisterous pouring forth from this diminutive source. We hear the song daily in May and June, and often glimpse the singer as he darts from shaded fence to sunny rose trellis.

Northern Mockingbird

This lively gray bird has distinctive white patches or "windows" on its wings which flash dramatically when it flies. Chances are, you'll identify the mockingbird by its song before you see it. It is an excellent mimic, singing repeated strains of almost endless variety in spring and early summer.

Mockingbirds are usually thought of as a southern species, but they have extended their range into Pennsylvania in recent decades. They are uncommon year-round. But some nest here, in shrubbery and orchards. Fruits and berries comprise nearly half their diet in season; berry-bearing shrubs are most likely to attract them to your garden. If they feel their nest is threatened, mockingbirds fearlessly scold and dive at domestic cats or other intruders, usually forcing the invader to retreat.

American Robin

The robin is the first member of the thrush family, indeed one of the first birds most people learn to recognize. The antics of robins as they run skillfully over the lawn, stalking and snaring earthworms, charm human observers every spring and summer. The broad, open expanses of trimmed grass with which people like to surround their houses provide excellent grounds for robin-style hunting.

The presence of robins in Pennsylvania doesn't always signal the beginning of spring. A few will stay here, quietly, in winter flocks. Then in March, robins appear in abundance, their welcome spring chorus foretelling dawn in April and May.

Nesting activities begin very early. The first brood hatched in their cup-shaped nest may die of exposure in the "onion snow." But the assiduous robins produce another clutch, and proceed undaunted with the task of providing to their demanding nestlings fourteen feet of earthworms every day.

The spotted breasts of half-grown robins show their relationship to the other thrushes. All young robins go through a transition period for a few days after leaving the nest but before they can fly. They spend this time running about on the ground, watched over by the male parent while the female prepares for another brood. This period is rife with hazards, notoriously neighborhood cats, but also well-meaning people who assume the young robins have been abandoned. People should never try to take over the nurturing of a young bird until they have watched it at length, and are sure no parent bird is nearby.

Eastern Bluebird

This favorite among eastern birds was called the "blue robin" by colonial settlers. It reminded them of the European robin they had left behind (the two birds are closely related). The eastern bluebird, unlike other thrushes, nests in holes or cavities. It has therefore suffered greatly from competition by two opportunistic imports — starlings and house sparrows — which have taken over prime nesting sites. Bluebird populations are being encouraged as people erect nesting boxes, with entrance holes small enough to exclude starlings.

Open country, roadside hedgerows, orchards, and parks comprise the usual habitat of this beautiful bright-blue and orange songbird. Here, insects and fruit are plentiful, and nesting holes likely.

European Starling

In Pennsylvania's cities and towns — in fact, in most urban areas of North America — the starling is one of the most abundant birds. How did this species become so common amid pavement and brick? A rather strange history explains this unusual association.

The starling was purposefully imported to Central Park in New York City in 1890. A well-meaning but misguided resident of that metropolis undertook an expensive project to import to the United States all of the birds mentioned in the writings of Shakespeare. So 30 pairs of ungainly, speckled-black, waddling birds, obscurely mentioned by Shakespeare's Henry IV, were carefully shipped to this country.

The undertaking proved to be more successful than anyone had thought possible. Successful, that is, if you consider sheer numbers as a measure of success.

Descendants of the Central Park starlings were first sighted in Pennsylvania in 1916. Soon, they nested from Nova Scotia to Georgia. They had crossed the Rocky Mountains by the late 1920s, and invaded Alaska by 1952. Millions now nest within a 50-mile radius of Washington, D.C. With their numbers and population density so great, starlings rapidly had become a pest species.

Although they consume huge quantities of Japanese beetles (also an import) and other garden pests, starlings probably do more harm than good. Their huge wintering roosts are noisy and filthy. They steal grain from feed lots, fouling what they don't eat. Possibly saddest of all, from the standpoint of bird lovers, they have taken over nesting cavities formerly used by our beautiful and once-familiar native birds, such as woodpeckers and bluebirds. Populations of bluebirds decreased rapidly as they were replaced by this opportunistic intruder.

Starlings will readily invade your back garden, no matter how careful you are to optimize the habitat for more desirable birds. Their black speckled bodies, yellow bills, and awkward waddling walk are easily recognizeable. Instead of "singing" as we usually think of bird songs, starlings emit a raucous collection of loud whistles and chatter.

In spring, starlings make use of almost any platform or cavity for their nests of grasses and trash. We have seen them feed crumbs from fast-food wrappers to their young, inside steel light poles in paved parking lots. This species filled a nesting void in North America — the opportunities of disturbed areas in cities. Unfortunately, they went far beyond this, to become the subject of extensive efforts in bird-population control. This aspect of starling biology is discussed further in the section on Bird Benefits and Detriments.

House Sparrow

The house sparrow, or English sparrow, is not closely related to native North American sparrows. This sparrow-like bird was imported into the U.S. from Europe during the 1870s and 1880s, by people who mistakenly felt that America was somehow lacking in songbirds and needed the "benefit" of the familiar birds of the Old World. House sparrows now live throughout the country, year-round.

The importers of these birds were doubly wrong. The Americas certainly did not lack songbirds, hundreds of species being present for their enjoyment had they opened their eyes and ears. And our country has not benefited from importing this bird. Quite the opposite. House sparrows are opportunistic, and have managed to out-compete and displace many native perching birds. Predominance by a single species diminishes the number of different species present in an area, reducing diversity as the natural ecological balance is disrupted.

House sparrows are not totally unpleasant birds, however. They have adapted to life in our cities, where virtually no native species dwell. Nesting above the outdoor walkways of shopping centers, and in niches in ornamental brickwork, house sparrows are oblivious to crowds and traffic. For people who live or work in high-rise buildings, where it is almost impossible to attract other birds, house sparrows usually are available. They will eat almost anything, and have become associated with the environs of fast-food restaurants and dumpsters. Their success at living in these places has caused them to become a pest species in some cities.

Bobolink

In the spring and summer, bobolinks nest and feed in tall grass and cultivated fields. They are renowned for singing in flight, a bubbly, seemingly joyous song, which historically inspired poets. The male bobolink in breeding plumage is the only North American land bird that has dark underparts and a lighter back. Females, juveniles, and males in fall have more subdued, sparrow-like coloring. Their distribution and numbers in Pennsylvania may be decreasing, as farmland is abandoned to grow up in trees or is converted to housing tracts.

Eastern Meadowlark

Meadowlarks are large and lovely summer residents of plowed fields and pastures. Their bright yellow breasts, with a broad black V marking, accent heavily streaked, brown and white backs. Males sing enthusiastically from powerlines or fenceposts, over their territories and their "families," which may include up to three nesting females.

Nests are well-built on the ground, and camouflaged to discourge predators. Unfortunately, because they often nest in cultivated alfalfa, many females and young are killed by mowing machines. If the female survives, the season is not too far advanced, and insects for food are still plentiful, she probably will nest again.

Common Grackle

Lawns, parks, and farmlands in Pennsylvania usually are visited by common grackles in the spring through fall. These large black birds do nearly everything in groups, preferring to nest in colonies in evergreen trees. Small flocks forage for an incredible variety of food items, including grubs and insects, small reptiles and birds, mice, minnows, nuts, and fruit. Grackles often roost at night in large shade trees, in huge mixed flocks with starlings, blackbirds, and cowbirds. When these roosts are in town, such large noisy flocks can be a serious nuisance.

Grackles can be distinguished from other large black birds by the iridescent green or purple tinge to their glossy black plumage, and the bright yellow eyes of adult birds. They are somewhat longer than similar black birds with which they might flock, though much smaller than crows.

Brown-headed Cowbird

Cowbirds are not endearing to people who enjoy watching nesting songbirds. They build no nest of their own, instead depositing eggs in the nests of other birds, especially sparrows and warblers. To assure the future success of their own offspring, cowbirds sometimes puncture the eggs of their unwilling host, or throw them out of the nest. Many of these victimized parents raise the cowbird young, which in turn may outcompete the bird's own nestlings for food, or push them out. They are certainly hard to love.

Male brown-headed cowbirds, not surprisingly, have brown heads, and black or dark gray bodies, slightly smaller than a robin. The females are very plain gray birds. The name "cowbird" was given to birds of this genus because of the habit of a different species of cowbirds to flock around cattle, picking ticks and other insects from their backs.

Orchard Oriole

Male orchard orioles resemble their counterparts among northern orioles, with the bright orange exchanged for brownish red. They sing beautifully from the treetops in orchards, tree farms, and along wooded farm lanes, flitting from branch to branch. The dull green and yellow coloring of the females helps them remain hidden in the foliage.

The striking eastern meadowlark with its yellow breast marked with a black V brightens the many agricultural fields where it's most often found.

Evening grosbeaks are sporadic winter residents in Pennsylvania. In some winters large numbers appear around backyard feeders where sunflower seeds have been provided; in other winters they don't appear at all.

Leonard Lee Rue

Although you might expect them to be destructive to ripening fruit, these orioles are helpful to orchardists, preferring insects as the main component of their diet. This bird is not really common in Pennsylvania, this being the northern edge of its breeding range. Often they nest near eastern kingbirds, a more aggressive species that discourages nest marauders.

Northern Cardinal

A common, vivid red inhabitant of thickets, open woodlands, and parks, the cardinal is a year-round resident of Pennsylvania. Both the male and the browner female have brilliant red crests and beaks, their beaks being suited to cracking the seeds that are a major component of their varied diet.

Female cardinals usually build their loosely woven nests in concealed tangles less than ten feet above the ground, and may rear two or more broods in a single season. The male often continues to feed the first fledglings until or after the next nestlings hatch. Intensely territorial, he will battle other cardinals to maintain his claim. His own reflection in a window or hubcap may incite combat!

Cardinals are attracted to backyard feeding stations stocked with sunflower seeds or cracked corn. They keep their bright red coloring year round, and it is particularly striking against a backdrop of snow.

Evening Grosbeak

Evening grosbeaks are highly visible winter residents of Pennsylvania. The males of these starling-size birds are bright yellow with black and white wings, females being similar but grayer. Colorful flocks of evening grosbeaks inhabit wooded suburban areas, feeding usually on the seeds and buds of evergreens. They also are attracted readily to backyard feeding stations, where they noisily crack sunflower seeds with their heavy bills.

The evening grosbeak's name is misleading; the birds actually are more active and vocal at early morning. Attracted in winter to salt spread on highways to melt ice, they are sometimes the victims of traffic.

House Finch

Originally a common bird of farms and towns in the western U.S., the house finches of Pennsylvania are the descendants of caged finches from California. Released in New York about 1940, they have become year-round residents of our fields and suburbs. House finches are similar in size and appearance to purple finches, although their red coloring is less extensive.

Thriving on a diet largely of weed seeds, house finches have adapted readily to the patchy and varied vegetation of mixed farmlands and housing developments, especially where they are encouraged by backyard feeding stations. Nests of house finches are usually at least five feet above the ground in the open interior of trees. But as with their feeding habits, their choices of nesting sites can be adapted to local conditions. They may nest in any natural or man-made cavity, or even reuse the nests of other birds.

American Goldfinch

These gregarious birds live in flocks in open fields and thickets. Seeds of weeds and flowers are the focal point for flocks of goldfinches, even during winter, when dried seed heads protrude above the snow. At feeding stations stocked with thistle or sunflower seed, they are as willing to pick at seeds on the ground as to jockey for positions on the feeder.

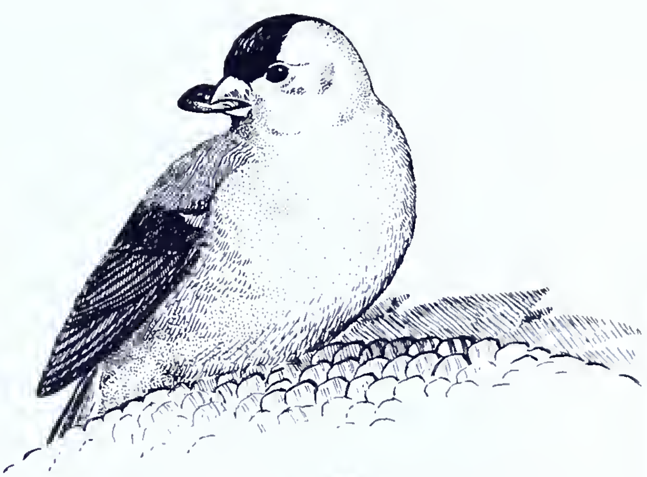
The nesting season of goldfinches is much later than that of most songbirds, extending from midsummer into September. This insures plentiful supplies of thistle down to line their woven nests, and insects and ripe seeds to sustain growing nestlings. During spring and summer, male goldfinches are lemon yellow with black wings and forehead. Grayish or olive-yellow plumage causes the males in winter to look more like the females.

A popular name for goldfinches is "wild canaries." You may think you have seen a wild canary if you spot this bright yellow songster eating dandelion seeds in your lawn; but there are no true canaries in Pennsylvania.

Sparrows of Fields and Suburbs

Even to many bird watchers, the multitudes of sparrows seem so numerous and so similar in appearance, with their various complex combinations of brown streaks and stripes, that it is difficult at best to distinguish one species from another. Familiarity with their songs and calls helps some, but these may seem as impossible to remember as their markings. Knowledge of habitat preferences and behavior may help you to make sense out of this confusing group of small, pleasing songbirds.

Many types of sparrows, including the seven described here, are at least part-year residents of the suburbs and farmland of Pennsylvania. Other sparrows inhabit forest margins, second-growth areas, and wetlands.



American goldfinches are year-round residents in this state, but they are probably most popular in the winter when they can be enticed to feeders with sunflower or thistle seeds.

Fallow, weedy fields and pastures in summer are filled with the buzzing of grasshoppers, and of **grasshopper sparrows.** An insect-like trilling song gave this bird its name. Strangely enough, grasshoppers also are a large contributor to this bird's food supply. Grasshopper sparrows devour a generous share of insect pests.

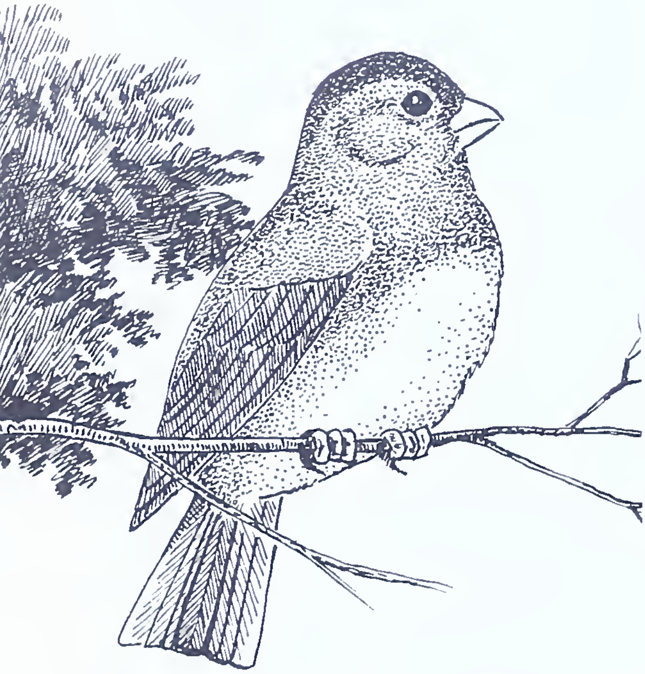
This stubby-tailed, brown-streaked, unassuming bird is more often heard than seen. During summer, it also inhabits brushy clearings on Pennsylvania's highest mountainsides. The male may be visible on the territory he has claimed, singing from a low perch on a weed stalk, or flitting short distances just above the undergrowth.

The **vesper sparrow** is another summer resident favoring brushy, overgrown fields and pastures. It hops or walks along the ground, catching and eating insects. Nearby trees along forest margins usually provide a nesting site.

Human listeners are charmed by the clear, trilling melodies of this plain little bird. Renowned for their evening song, for which they were named, vesper sparrows sing during the nesting season throughout the day and even into the night. Although they usually avoid areas of human habitation, they may be observed taking dust baths in country roads during the dry months of summer.

A common winter resident throughout Pennsylvania, **dark-eyed juncos,** or "snowbirds," are easily distinguished from other sparrow-size birds by their simple color pattern. Male and female juncos have similar dark head and back contrasting with a solid white breast. Small flocks of juncos inhabit brushy and weedy fields, rhododendron thickets, roadsides, and parks. They are frequent visitors to feeding stations in suburban areas with mature trees and shrubs. Here, the birds walk or hop along the ground, picking or sometimes scratching lightly at seeds under shrubs or bird feeders.

Female juncos build nests in late spring or summer, on the ground, tucked neatly out of sight under stumps, brushpiles, or overhanging stream banks; or on man-made structures such as protected windowsills. In Pennsylvania, they nest only in the northern counties and at higher elevations.



Dark-eyed juncos, or snowbirds, nest in the northern mountainous areas of Pennsylvania, but they can be found throughout the state in winter, wherever bird feeders are maintained.

Pennsylvania winters are enlivened by the presence of **American tree sparrows.** They resemble chipping sparrows in appearance and behavior, and may be thought of as the "winter chippy."

A distinctive dark spot on its breast is the most recognizable field mark of this pleasant little seed eater. Look for this unique "breast button" or "stickpin" on streaked brown sparrows in winter flocks with juncos, to recognize the tree sparrow.

Formerly a resident of forest margins, the **chipping sparrow** over the years has adapted well to life in suburbs and farms. The distinctive rusty cap, black bill, and black and white eye stripes are useful field marks, distinguishing the "chippy" from other small streaked seed eaters.

In Pennsylvania, female chipping sparrows build their nests in evergreens or orchards. They prefer to line their nests with hair, horse tails being the historical favorite. But due to a modern-day lack of horses, they have been known to steal hair from many sources, including sleeping dogs!

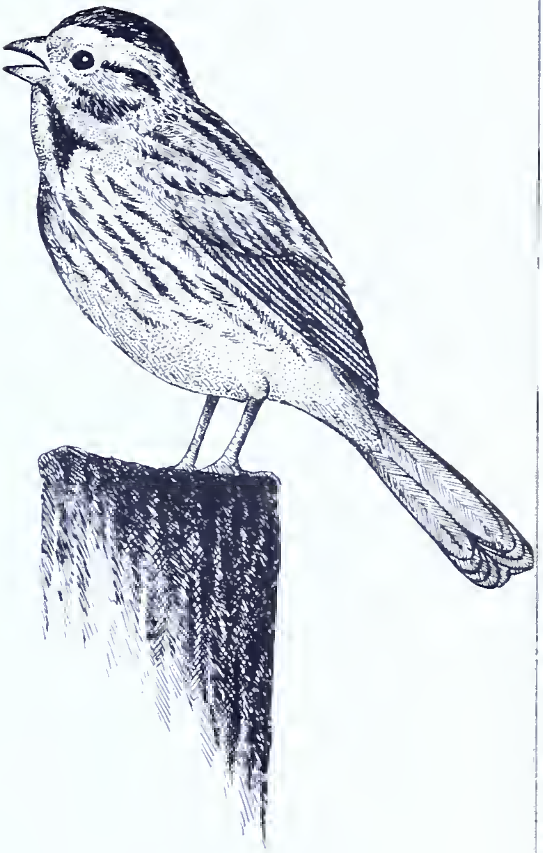
The single-pitched "chip" notes of the chipping sparrow's dry trilling song gave the bird its common name.

The fields preferred by the timid, insect-eating **field sparrow** are not those of cultivated farms. Field sparrows inhabit pastures grown up to weeds, briars, and sumac. These areas provide them with ample and varied food items, and huckleberry brush or saplings in which to nest.

Physical resemblance between field and chipping sparrows can be confusing. Notable distinguishing field marks include bill color — black for chipping, reddish for field sparrows — and facial stripes and cap, which are much more pronounced on chipping sparrows. Both of these birds breed in Pennsylvania, but rarely winter here.

Field sparrows are often thought to be more reclusive than their sparrow

To the novice birdwatcher, the array of sparrows may seem overwhelming, but a knowledge of which species are around at various times of the year and their distinctive characteristics permit identification. The song sparrow can be recognized by its streaked breast and dark chin stripes and the fact that it is an abundant breeding resident, even in the suburbs.



cousins. With luck you may catch a glimpse of them, flitting low through brush and brambles.

Even if its source is not always identified, the varied, pleasant song of the **song sparrow** is frequently heard throughout Pennsylvania. Any time of day and through all seasons their song is in the air, near ponds, in brushy meadows, along fencerows, and in backyards and parks, where the birds nest and feed.

In basic brown and white, heavily streaked breasts and dark chin stripes or "muttonchops" characterize both sexes. Female song sparrows build their grassy woven nests on the ground early in the season. Shrubs and weedy clumps may support their later nesting activities. Song sparrows often are the unwilling host and foster parents to brown-headed cowbirds.

Indigo bunting, by Linda Reinbold. This iridescent songster—the female is dull brown in color—is a common breeding bird in shrubby areas throughout the state.

Red-winged blackbirds, by Ned Smith. During the nesting season, redwings can be found throughout Pennsylvania, especially around wet areas.

Red-bellied woodpecker, by Linda Reinbold. This woodpecker is an uncommon species here, found mostly in the southern counties, but its range is apparently moving northward.

Eastern bluebird, by Ned Smith. Once considered a harbinger of spring among rural and suburban dwellers alike, over the past several decades bluebirds have been driven from many favored haunts by the more aggressive house sparrows and starlings.

Northern cardinals, by Ned Smith. These common birds apparently do well around people, nesting around homes in ornamental shrubbery in the summer and feeding on sunflower seeds at feeders in the winter.

Eastern meadowlark, by Ned Smith. The insect-like trill of the meadowlark is a common sound in rural areas through the spring and summer months.

Hooded warbler, by Ned Smith. Experienced birders watch for the flashings of the hooded's conspicuous white tail spots in rhododendron and laurel thickets.

Pileated woodpecker, by Ned Smith. This year-round resident can be found wherever large old trees are available for nesting and feeding.

Linda Reinbold

NED SMITH
1965

Linda Reinbold

NED SMITH
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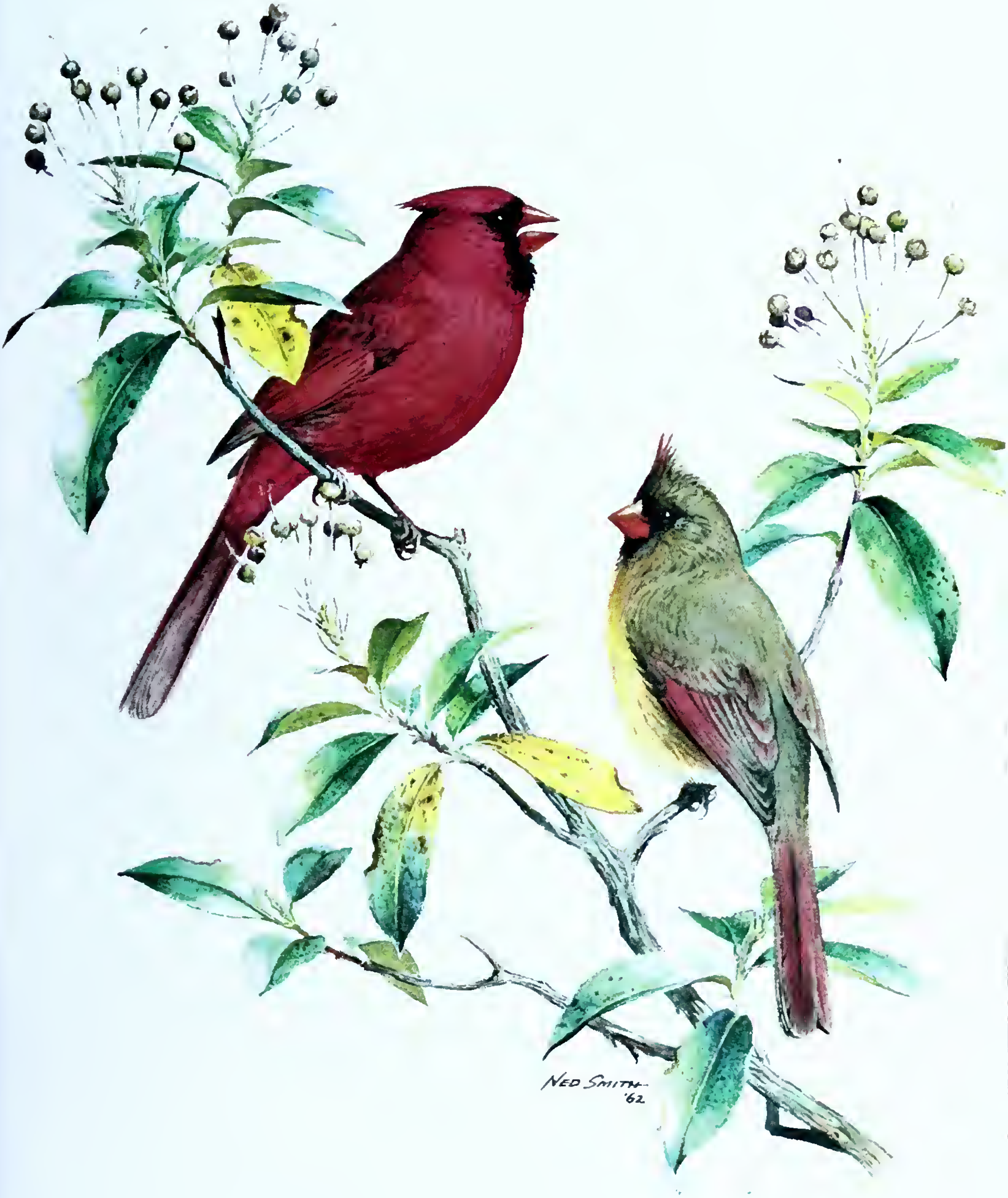
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Forest Margins and Second Growth

Forest margins and areas of second-growth trees are inhabited by many wildlife species, and are home for birds requiring habitat which is less disturbed than suburbs, but more open than continuous forests. This habitat type includes the borders between forests and fields, and regions where timber has been harvested or where fire has removed the mature trees. Diversity of plant species in regenerating areas encourages varied birdlife.

The kinds of plants present will depend on factors such as slope and drainage, and the type of forest or fields found nearby. Grasses, berry- and seed-bearing shrubs, and small trees may all be present. Depending on the closeness of active farms, suburbs, forests, or water, these areas will support many of the bird species listed for the other habitat types, in addition to those listed here.

American Woodcock

After wintering in the southern states, woodcock return to Pennsylvania and points north for breeding and summer feeding. They depart from their winter quarters in January or February, making their annual northward trek in four to six weeks.

Woodcock feed primarily by probing for earthworms in soft mud; thus they time their arrival to coincide with the spring thaw. Late snows and unexpected cold snaps can be fatal. Their long stiletto-like bills are superbly adapted to their feeding habits. The upper mandible is flexible. With the entire bill submerged in mud, they can actually feel for worms. This behavior earned them one of their popular names: "bogsucker." During dry spells, they alter their menu to include slugs and insect larvae, available by probing among fallen leaves.

Woodcock are most active at times of subdued light — dawn, dusk, rainy days, moonlit nights. Picture the woodcock standing in a boggy field in the evening, with his entire two-and-three-quarter-inch bill straight down in the mud. In this position, it seems he should be terribly vulnerable to attack by predators. But along with developing this singular foraging style, woodcock also developed special physical features for coping with the risks. They have extremely large eyes, which are set high and far back on the skull. This arrangement permits them to see above and behind their heads. Seeing forward is of little use if your face is down in the mud! They effectively have "eyes in the back of their head," to keep a wary lookout for danger. Their brains are nearly upside-down, to permit this ocular adaptation, unique among birds.

Upon his return in the spring, the male woodcock's first order of

The American woodcock frequents wet areas where it feeds primarily on earthworms. With its long pointed bill, it can feel for worms as much as three inches below ground level.

Karl H. Maslowski

business is establishing a courting territory. His famous flight song and display are the mechanisms by which he claims the right to breed. By the time the females arrive, singing grounds are well established, and morning and evening courtship sounds fill the air. With the females sequestered nearby in the brush, the male begins calling a buzzy "peent!" from a small clearing. Periodically he ascends into his flight display, circling upward some 300 feet with a whistling of wings. At the zenith of his circling, he begins a melodious chirping song before fluttering to earth, back and forth like a leaf drifting downward. The whole process takes only a few minutes, and is repeated several times between dawn and full light, and between sundown and darkness. Copulation with the females that he has impressed may occur at any time between flight songs. Their entire association amounts to nothing more than a quick tumble in the bushes.

Female woodcock nest on the ground in brushy and weedy margins, often near singing fields. Their coloring and mottled feather patterns provide near-perfect camouflage among the dead leaves surrounding the nest site. Females are larger than males, weighing about half a pound. To them falls the entire responsibility of nesting, incubating, and raising young. As with many ground-nesting birds, the chicks mature quickly. Within two weeks from hatching they are able to fly short distances, out of harm's way.

Ideal habitat for woodcock singing and nesting consists of abandoned farmland, growing into brush in some areas but with small clearings remaining. Damp, boggy areas fitting this description are best. Sadly, populations of woodcock in Pennsylvania have been declining, at least since the mid-1960s. There are several reasons for this decrease. Urban areas have absorbed forset edges. Highways and other developments now cover bottomlands and valley margins. And much of the abandoned farmland which formerly provided mixed brush and clearings has matured past the ideal stage for woodcock habitat.

Cuckoos

Hot, humid summer days along brushy country roadsides and thickets may be punctuated by the clicking, guttural songs of cuckoos. Both **yellow-billed** and **black-billed cuckoos**, two separate species, are breeding residents of Pennsylvania. They are sometimes called "rain crows" because their song can be a portent of impending storms. These brownish, slender, long-tailed birds are quite attractive, however, and do not resemble crows.

Newly hatched young cuckoos are ugly. They quickly grow quill-like feather sheaths, which do not enhance their looks. But after about a week in this unappealing condition, the sheaths split to reveal well-formed feathers. The birds are transformed to resemble their parents within a few hours.

Cuckoos use their curved bills to capture hairy caterpillars, which they consume in enormous quantities. For this reason, the cuckoos' songs are heard perhaps more frequently during caterpillar outbreaks. Cuckoos have a unique mechanism for dealing with the indigestible spines of their prey. A hairy mass of spines builds up on their stomach linings, which they shed periodically, spines and all.

The birds themselves hide in the foliage, and are not easily observed. Field marks distinguishing the two species of cuckoos are somewhat subtle. You probably will need a field guide and binoculars to distinguish between them physically. Their voices are quite distinctive, once you are used to them. We have heard the unmistakable low cry of a black-billed cuckoo on rainy May nights, long after most birds had fallen silent.

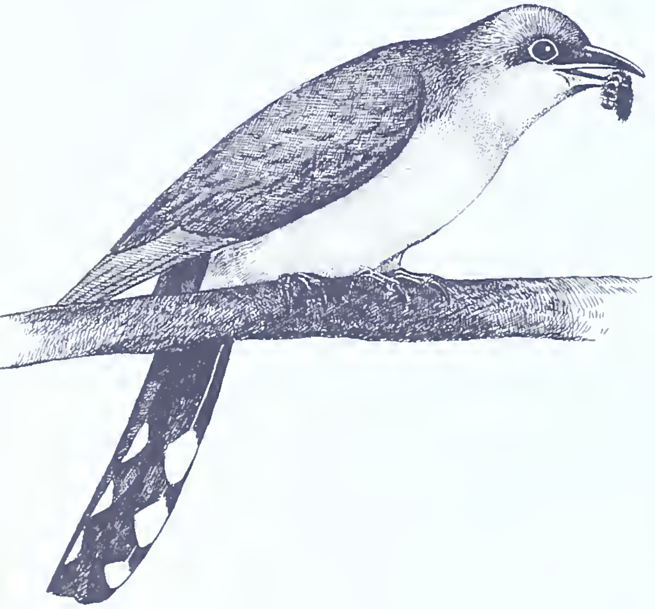
Carolina Wren

Not common in Pennsylvania, Carolina wrens have extended their breeding range northward in recent decades. A buffy breast and prominent white eye stripe distinguish it from the smaller, darker house wren. Carolina wrens prefer brush heaps, rocky areas covered with brambles, and fallen treetops for nesting and feeding. Their sunny, chattering song may be heard year-round, as they dart in and out of woodpiles and shrubbery.

Gray Catbird

Its peculiar, cat-like mewing call gave this bird its name. A sleek dark-gray bird, the catbird's only other colors are a reddish patch under the tail and a black cap. Although they lack the perfection of their mockingbird cousins, catbirds are mimics. A catbird in our garden did a fair job of sounding like a northern oriole, and even tried to sing "whip-poor-will." The notes were awful but the rhythm was right.

Catbirds eat about half insects, half fruit and miscellaneous items. They are notorious pilferers of grapes and strawberries. Ornamental shrubbery and hedgerows provide nesting cover, and adults may raise two broods per season. In spring and fall, catbirds migrate at night. Many of these beautiful birds are killed striking tall buildings or broadcasting towers. A few catbirds remain in the state through the winter.



Both the yellow-billed, illustrated here, and the black-billed cuckoos are attractive, long-tailed birds, but they are not often seen because they live in treetops. Caterpillars apparently are a favorite food of both species.

Brown Thrasher

Brown thrashers are robin size, but are slim, long-tailed birds. They are as fearless in defense of their nests as other birds of this family (see Mockingbird). They will assail any animal, wild or domestic, that seems to threaten their offspring. The beautiful, reddish-brown thrasher has a heavily streaked breast and at first glance is similar to the plumper wood thrush. The longer bill and tail and light-colored eye of the trasher should be recognizable.

Thrashers sing loudly and musically from the undergrowth in spring and early summer, in multiple phrases usually repeated twice. They also mimic the songs of other birds.

Feeding on the ground, brown thrashers use their long curved bills, rather than their feet, to root out insects and grubs. They nest on the ground in thickets, or low in fruit-bearing shrubs which provide both cover and food.

Cedar Waxwing

This unusually sleek, crested bird is a year-round Pennsylvania resident. Berry-bearing trees and shrubs attract quiet flocks of these beautiful fawn-colored birds. Fruits and berries are so vital a food supply that the waxwings nest in late summer, when mulberry, pyracantha, and cedar berries are ripe. This guarantees ample food for their nestlings. They readily share the food supply with others of their kind. Members of a single flock have been seen passing a berry among themselves, from beak to beak, until one bird finally swallowed it. Overripe fruit can cause the birds to become inebriated. Except for nesting, waxwings claim no individual territories, but remain most of the year in small, friendly flocks. Their call is so soft and high pitched that it eludes some human listeners. If you hear one waxwing, listen for the whole flock in surrounding trees.

Warblers of Forest Margins

There are many warblers which spend part of the year in Pennsylvania. There are, after all, more than 50 species of New World warblers in North America. Other warblers are introduced in the chapters on Deciduous Forests, and Coniferous and Mixed Forests.

Fruits are such an important food item for the pastel-colored cedar waxwings that their breeding season coincides with fruiting periods for mulberry and other trees and shrubs.

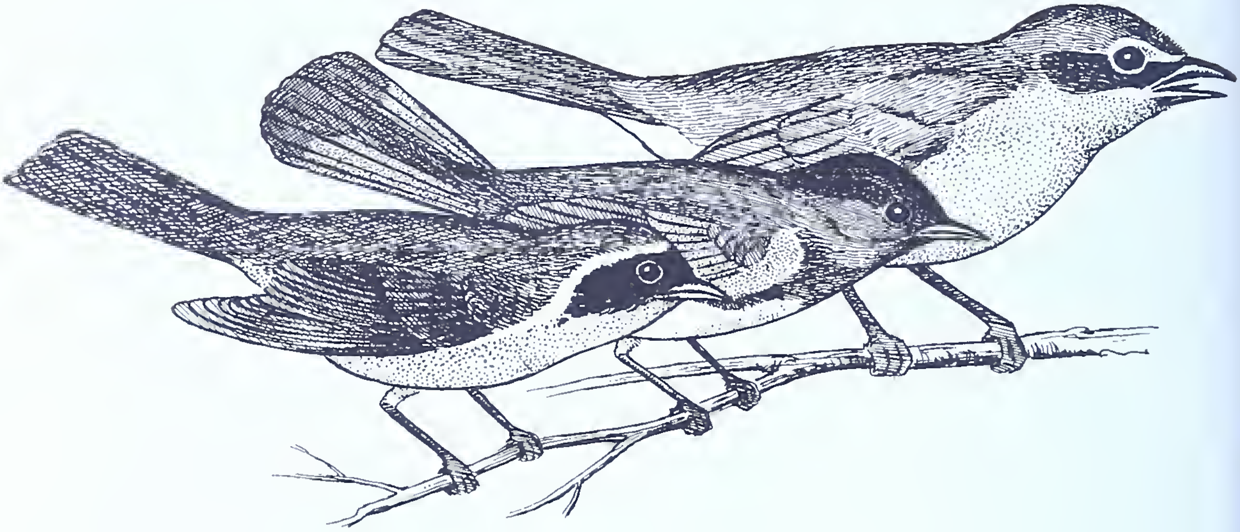
Most warblers of shrubby, second-growth areas are small, brightly colored birds with sweet musical or buzzing songs. Like woodland warblers, they tend to be reclusive most of the time, and to thrive on a diet of caterpillars and insects.

The song of the **golden-winged warbler** is one of the easiest to learn and remember. On hot sunny days, their lazy "bee-bzz-bzz-bzz" is heard from thickets and tree limbs. These warblers nest on the ground, a fairly dangerous place for their tiny nestlings. But the young warblers mature rapidly, and 10 days from hatching they are climbing and fluttering about in the shrubbery.

Nashville warblers also nest on the ground. They hide carefully built nests under a thick shrub or in a clump of grass. Incubation of the tiny eggs, the job of the female, is aided by a nest lining of soft moss and rabbit fur. The male defends the nesting territory, singing loudly and musically from midway up the trees. Nashville warblers also feed in orchards and wooded back gardens.

Yellow warblers are one of the best known species of this group. Their sunny yellow plumage enhances thickets and garden shrubbery. A very musical song, like "sweet-sweet-sweet-I'm-so-sweet!" will lead you to these happy-sounding birds. Arriving in their breeding range in May, the yellow warblers have completed the process and departed by late July. Their nests are frequently parasitized by cowbirds, resulting in yellow warblers raising many cowbird young. But sometimes the warbler parents build a new layer to the nest, covering and abandoning the cowbird eggs, and possibly some of their own. Fortunately the female warbler can lay again.

Another musical resident of deciduous brush is the **chestnut-sided warbler.** A penchant for grown-over pastures and hedgerows may have helped it expand its range. It is now fairly common in the margins of farm country. Flitting back and forth from the ground to the crowns of trees, this sprightly bird gleans insects from the



Three species of warblers often seen in woodland margins are, from left, common yellowthroat, American redstart, and the yellow-breasted chat. Despite their bright coloration, warblers are relatively inconspicuous and are therefore most often first located by their songs.

foliage of shrubs and vines. Its "chestnut sides" are reddish-brown stripes, a distinctive field mark.

The **common yellowthroat** sings distinctively from tangles, overgrown roadways, and swampy thickets. Its "witchety-witchety-witchety" is remarkably loud and musical, and easily remembered. The lemon-yellow throat and rakish black mask of the male are clearly visible as he perches atop a cattail or snag to announce his presence.

Yellowthroats build large nests of plant fibers and animal hair. Although they hide their nests in tangles of weeds, cowbirds often find them.

The **yellow-breasted chat** is a most unwarbler-like bird. It looks rather like an enormous common yellowthroat. But its size and behavior are more suggestive of a mockingbird. In fact, one popular name is the "yellow mockingbird." Its song is distinctly unmusical. Low swampy thickets and brushy pastures may be filled with chat noise, a variable medley of whistles, clacking sounds, and, to the ears of humans, harsh chatter.

Second-growth scrub may host **Canada warblers** along with the other warbler species. Black streaking under its yellow throat, usually called its "black necklace," is a distinctive field mark for males in spring and summer. Gnarled roots or rotten stumps make ideal nesting sites, with separate territories carefully delineated for each pair.

May in our backyard is always made more special by the fleeting appearance of migrating **American redstarts.** The male redstart is black with flaming orange patches on his wings and tail. A bundle of nervous energy, he leaps and dances through the new leaves of deciduous trees and brush. The female flits along with him, a dark-gray and yellow version of the same striking feather pattern.

Redstarts breed in some areas of Pennsylvania. The female does all the work of nest building and incubating. Maintaining a feeding territory of an acre or more is the special task of the male, and requires constant vigilance. Redstarts become more sociable and gregarious in late summer, preparing for their annual migration to Central America.

Northern Oriole

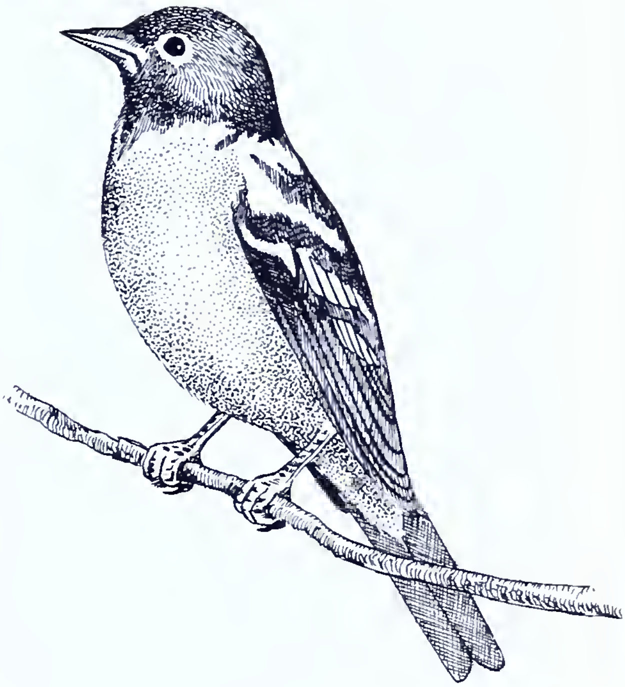
Tall deciduous trees are preferred by northern orioles. Elms were their historical favorite. Now that elms are scarce, they will live and nest in large maples, birches, orchard trees, or sometimes conifers, eating huge quantities of caterpillars and bugs. Orioles sing their loud, beautiful song from a high hidden perch during the nesting season, and again shortly before fall migration, after a quiet and reclusive summer. The orioles in our neighborhood seem to change their song every year. At least the whistling clarity, pitch, and timing always are recognizable.

Northern orioles formerly were called "Baltimore orioles." They were given this name in the 17th century, when colonists in Maryland likened the brilliant orange and black plumage of this bird to the family colors of the Lords Baltimore of that colony. These beautiful birds now enliven forest margins and country roadsides, as well as wooded suburbs and parks.

Indigo Bunting

Abandoned farmland, forest margins, scrubby fields, even clearings for powerlines and mountain roads, are the preferred habitat of indigo buntings. Here, the bright blue male can find a conspicuous perch from which to announce his territorial claim, while the plain brown immature and female birds remain in the protective cover of shrubs. Male indigo buntings, sometimes called "blue canaries" or "indigo bluebirds," appear to be solid turquoise blue in the sunlight. Against the sky or in the shade they may appear black. Bunting nests, built a few feet off the ground in shrubs, are constructed of grasses, bits of fiber or animal hair, and thistle down. Nesting may occur any time from May through August.

Male indigo buntings call attention to themselves by singing throughout the day in mid- to late summer, usually from a high exposed perch such as a powerline or dead branch, where they are easy to observe.



The northern oriole, formerly called the Baltimore oriole, is a breeding resident in the state and can often be seen and heard in the tops of trees lining suburban streets as well as those in woodland edges.

Common Redpoll

Flocks of common redpolls occasionally invade Pennsylvania during the winter months. The red-capped, brown-streaked redpolls eat the seeds of nearly anything, favoring especially dried weeds, and small shrubs and trees, such as birch and alder. Having an unusual resistance to cold, these bold little birds may bathe in icy creeks, or scratch and dig energetically on the ground in snow.

Redpolls are much smaller than the other reddish winter birds of Pennsylvania, such as crossbills and finches. Their size, field marks, and behavior should aid recognition. They appear at our feeding stations in the company of goldfinches and pine siskins.

Rufous-sided Towhee

The dry ground and dead leaves of upland second-growth thickets might seem to be unlikely habitat for a pretty songbird. But here the rufous-sided towhee resides, scratching and rustling noisily in the duff of heavy undergrowth and wood margins. The reward for the towhee's ground-based scuffling is a plentiful diet of grubs, beetles, and berries, with an occasional small lizard. Shunning the treetops pays off for towhees.

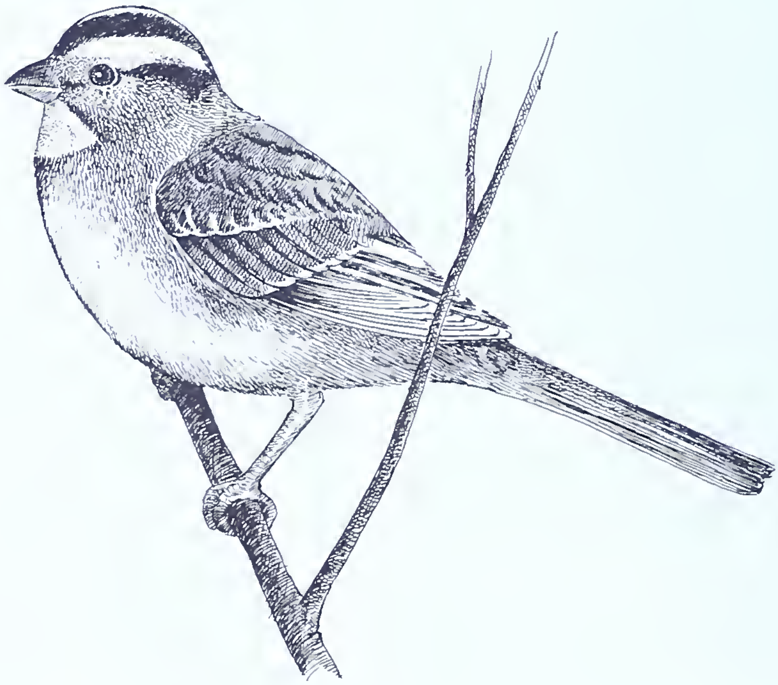
Not prone to flocking, pairs of towhees can be seen in brushy areas of Pennsylvania, including well-established suburban hedges, from April throughout the summer and early fall, and sometimes through the winter. They may be attracted to feeding stations for suet or flax seed, but usually only if there is both adequate shrubbery and the opportunity to scratch for fallen seeds beneath the perches of other birds.

Nests are built commonly within five feet of the ground, in brush piles or clumps of grass and shrubs. The cheerful and distinctive "che-WINK" call of the towhee is unforgettable. In the proper habitat, their call often can be heard when even the birds themselves are obscured in the undergrowth.

White-throated Sparrow

Distinctive field marks for this active little sparrow are, as implied by its name, a conspicuous white throat and a black-and-white striped head. This attractive bird is most often seen in Pennsylvania during the winter, as it scratches on the ground in leaves and brushy edges, seeking seeds and grubs. White-throated sparrows also visit wooded suburbs in winter, and will feed on the seeds which other birds drop from feeding stations.

The sweet song of the white-throat is usually translated "old-Sam-Peabody-Peabody-Peabody." Unfortunately, this charming whistled song is at its best during the breeding season, when the birds are farther north. In winter, they sing an abbreviated but still recognizable version.



The white-throated sparrow is a relatively easy sparrow to identify because of its conspicuous white throat and its loud "old-Sam-Peabody" song.

Deciduous Forests

Forests cover 56 percent of the Commonwealth of Pennsylvania. These forestlands include some coniferous and mixed forests, but the predominant type is deciduous forest, the familiar woodlands renowned for beautiful fall foliage. In central and southern Pennsylvania, oaks are the most common deciduous forest trees. Maple, birch, and beech are common locally, and predominate in northern counties. Cherry and aspen are also fairly common throughout the state, especially in tracts where forests are less mature.

In contrast to residents of more open areas, forest-dwelling birds can be difficult to observe. The continuous canopy of Pennsylvania's woodlands provides dense cover in spring and early summer, the active periods for breeding songbirds. Some of the larger forest birds are nocturnal, as is the screech owl. Some are rare and reclusive, as are goshawks and pileated woodpeckers. Learning bird songs, especially the beautiful melodies of thrushes and warblers, will help in locating and identifying forest-dwelling birds. The sounds of owls, turkeys, woodpeckers, and hawks also are distinctive.

Nuthatches, chickadees, titmice, woodpeckers, brown creepers, and other songbirds in this group may reside in quiet, forested residential areas. Winter residency of mixed flocks of these birds can be encouraged by feeding stations.

Turkey Vulture

Commonly but mistakenly called "buzzards," turkey vultures are one of North America's largest land-based birds. But they are seldom a favorite. Their featherless faces and carrion-eating habits are repulsive to many people. Their naked red heads were thought to resemble those of turkeys, and thus they acquired their name.

In the air, turkey vultures are amazingly graceful birds. Once airborne, they rise effortlessly on ascending thermal currents. Flight patterns can be carefully adjusted by changing the tilt of the V-shape of their outstretched wings. For hours, as the morning warm air masses rise, they soar many miles without flapping.

By both sight and smell they can locate dead animals on the ground hundreds of feet below them. One circling vulture often attracts others. Landing in groups, they feed on the refuse of others' mortality, harming nothing and in fact helping to dispose of the mess.

Cliffs, small caves, and hollow trees will host incubating vultures. A standing dead tree in a remote swamp or a long-abandoned building might also attract them, to lay their eggs with no nest. Five or six weeks of incubation produce their offspring, which they

Perched on an old weathered snag, the turkey vulture would probably win no beauty contests; but while soaring gracefully on rising air currents, turkey vultures have few peers in the bird world.

Irene Vandermolen

feed by regurgitation. The young vultures mature slowly, and do not fledge until 10 or 12 weeks after hatching. Young vultures are ready to migrate to Central and South America for their first winter.

Black Vulture

The black vulture is not a common nesting resident of Pennsylvania. Ranging usually throughout the southeastern U.S., they do invade the state occasionally, and will nest in some areas. Black vultures are less perfect soarers than turkey vultures, having larger bodies relative to their wings and shorter tails. They must flap more often to remain aloft. Flight with their wings out straight distinguishes them from the V-shaped profile of soaring turkey vultures. Wheeling overhead they expose white patches near their wingtips, which an observer on the ground might recognize. Black vultures are reputed to kill young birds and small mammals for food. But, like turkey vultures, they mostly eat carrion, cleaning the refuse from roadsides and dumps.

Cooper's Hawk

The Cooper's hawk looks like a small goshawk or a large sharp-shinned hawk, both of which are included with birds of coniferous and mixed forests. Indeed, the size differences between the larger females and smaller males of each species are so great — as much as three inches difference in wingspan for Cooper's hawks — that size ranges of individuals almost overlap among the three hawks. Nesting pairs usually will not tolerate another pair of the same or either of the other two species on their breeding territory.

Historically and until early in the 20th century, when most households kept a few chickens in the dooryard, this hawk was generally viewed as a "chicken hawk." Free-roaming fowl are far less common now, and Cooper's hawks usually hunt starlings, which they catch in the air. But the unfortunate and largely unearned nickname is still used. The hawks themselves have become fairly rare, through combined pressures of human enemies, habitat decline, and lethal effects of pesticides.

Red-shouldered Hawk

Early in spring, red-shouldered hawks return to their familiar nesting sites within lowland forests. Pairs remain mated year after year, and either they or their offspring home to the same tract repeatedly. They announce resumption of residency with a loud, typically hawk-like call, sometimes perfectly mimicked by blue jays.

The red-shouldered hawk is a large soaring hawk, with habits and appearance quite different from those of accipiters (goshawks, Cooper's hawks, sharp-shinned hawks). They tend to prey on mammals which they hunt from high soaring or from a static perch. Unwary mice and rabbits quickly become dinner in the powerful clutch of the hawk's talons.

The crow-size Cooper's hawk is probably most often seen in the winter when attracted to birdfeeders where it may prey upon songbirds.

The red-tailed hawk may not be the most common hawk in the state, but the fact that it is often seen soaring over farmland and open areas makes it one of the most visible.
Karl H. Maslowski

Red-tailed Hawk

Soaring high over farms and hills, the red-tailed hawk wanders widely from her nesting site in upland forests. The larger female may incubate and raise young in the same nest for many seasons, adding new twigs to repair the winter's damage. Her smaller mate, commonly monogamous for life, is a tireless hunter of small rodents to feed the growing hawklets. They also winter over much of the United States, and are seen frequently in all months in Pennsylvania.

Like other large buteos (soaring hawks), red-tailed hawks have eyes nearly as big as those of humans — hard to imagine in a bird only two feet long from head to tail! The special construction of their enormous eyes permits them, as they soar, to see mice running on the ground hundreds of feet below. They are able to discern at a glance details which humans would require much longer to assimilate. But the relatively small size of their heads leaves little room for eye-moving muscles. In order to see from side to side, they must move their heads constantly, focusing instantly on everything around them.

Broad-winged Hawk

The smallest of the buteos, broad-winged hawks are about the size of crows. Nesting sites, anywhere in the eastern half of the United States, are usually chosen in dense forests, frequently near wetlands. Swampy ground hosts frogs, toads, snakes, and large moths, which are staple items of the broad-wing's diet. These hawks are most commonly seen during spring and fall migration. At the Hawk Mountain Sanctuary, a renowned observation spot on the usual migration route, thousands of broad-winged hawks fly overhead during the peak migration period (September and October).

Golden Eagle

The best time and place in Pennsylvania to see golden eagles is during the fall migration at Hawk Mountain. They do not nest and rarely pass the winter in Pennsylvania, although young birds explore their way into the state from time to time. Golden eagles are tremendous soaring birds, able to spiral upward on rising air currents, making infinite adjustments in balance with the tips of their dark wings. A seven-foot wingspan provides a lot of lift.

The golden eagle's worst enemy is man. Despite massive evidence to the contrary, many Western ranchers still assume that the eagles steal and eat lambs. Rabbits and ground squirrels comprise a large percentage of their meals — domestic animals usually are consumed only as carrion.

Wild Turkey

In many areas of Pennsylvania, the turkey once again is a common gamebird. Populations of turkeys in the northern and eastern states were decimated early in the 19th century, by declining habitat and hunting pressure. But programs of capture and release, transplanting turkeys to areas of ideal habitat, have turned the tide. In Pennsylvania, with the help of the Game Commission, turkeys have refilled their former range.

Ideal habitat for turkeys fulfills several specific requirements. There must be large trees for night roosting. Seeds, nuts, and acorns must be obtainable from ground foraging in winter. In warmer weather, fruits, buds, insects, and other animal matter should be plentiful. Turkeys nest on the ground, so there must be hideaways for incubating and rearing young. Where all these requirements are met, turkeys flourish.

The largest gamebirds in North America, turkeys have a wingspan of four or five feet. When it is expedient to do so, they can fly swiftly and straight, if noisily, for relatively short distances. But they are not built for long-range flight, and do not migrate. They wander widely on foot, however, especially in foraging winter flocks.

The courtship display of male turkeys is an impressive sight. Spring is their noisy season, when the males try to attract potential mates to a woodland clearing, where they can show off. Children usually draw turkeys strutting with their showy tails fanned out. This is strictly a springtime courtship display, and of short duration. Three to five females comprise the harem of a successfully competitive male. The females in turn nest and raise the poults (young turkeys) without any help from their polygynous mate. Several females may share the responsibility at a common nest. The poults are able to forage with the females almost immediately. By the age of one month, they can fly up to treetop roosts.

Turkeys were domesticated centuries ago by native Americans. Spanish conquerors took turkeys back to Europe, where the birds have been raised as barnyard fowl ever since. This bird was confused by Europeans with a guinea fowl imported from Africa by way of the Turkish Empire at about the same time. Both the African and North American birds thus came to be called "turkeys."

Ruffed Grouse

Grouse are among the most popular and sought-after of game birds. The ruffed grouse has so endeared itself to Pennsylvania that it is our official state bird. Their habit of escape, with an explosive thunder of wingbeats when startled, also makes them highly visible.

Grouse are not constructed for long migratory journeys. Although their wings span two feet or more, they are short and broad relative to the grouse's body. The wings and tail are designed for maximum flight control in tight situations. Grouse easily make light-

As a result of successful trap-and-transfer programs, the wild turkey has become reestablished around the state to the point where it is now the most popular gamebird with many Keystone State hunters.

ning-fast corrections in aim, launching themselves out of dense thickets, in between the seemingly impenetrable canopies of shrubs and trees, with no collisions.

Drumming by male grouse in early spring ushers in the breeding season. Each competitive male chooses a fallen log or stone giving him a firm footing and a vantage point above the forest floor. Choice drumming logs are worn smooth through the years. Bracing his stance with his tail, the performer begins beating the air in short powerful forward strokes. Air movement alone produces his characteristic low rolling thunder, a sound that carries several hundred yards. A dominance challenge to other male grouse, the muffled roar of drumming also attracts females ready to mate. Pairing lasts only long enough for breeding. The female departs quickly for her solo task of nesting and rearing young. Her place soon may be taken by another independent female.

Hatched on the forest floor, young grouse are able to get around on their own early in life. In autumn, grouse become less solitary. Small flocks may relocate in mixed forests or stands of evergreens for winter foraging. Although spring activity is the most concentrated, drumming has been heard in Pennsylvania forests virtually every month of the year, day and night.

Owls of the Forest

Seven common owls are divided among four of the habitat types, depending on the type in which they are most likely to live. Two owls are readily associated with deciduous forests.

The almost exclusively nocturnal screech owl often spends the day perched on a limb close to a tree trunk. Its quavering whinny may be heard just about anywhere in the state, especially in spring and fall.

The **eastern screech owl** is not strictly a forest bird. Its hunting activity, almost exclusively nocturnal, takes this small owl to open woodlands and clearings in dense groves. Almost any small animal — mammal, amphibian, bird, or insect — is fair game. By day, they rely on cryptic plumage and secret perches for safety. Their plumage comes in two distinct color phases, one grayish and the other reddish brown, which are not related to age, sex, or geographic distribution.

Notorious nest defenders, screech owl parents might dive-bomb unsuspecting night walkers approaching too close to their nursery. They don't actually build nests. Small cavities, such as abandoned woodpecker holes, and large nest boxes are inviting places in which to rear their young. The call of the screech owl is more of an eerie whinny than a screech. Nocturnal activity makes them far more often heard than seen.

Nearly as large as great horned owls but lacking their ear tufts, **barred owls** are common forest dwellers throughout the eastern United States. Noiseless and skillful in flight, through dense forests and open glades, they are expert hunters. Dawn and dusk are active periods, making the barred owl somewhat more visible to humans.

The distinctive call of the barred owl is heard in all seasons. They emit stylized, rhythmic low-pitched hoots, usually rendered into words: "Who cooks for you? Who cooks for you-all?" Once heard, the call is easily remembered. Barred owls choose nesting sites similar to those of screech owls, though of course much larger. The birds are about 20 inches long to the screech owl's 10 inches.

Whip-poor-will

The common name of this night flier is based on its three-note song. Times of growing darkness or light are filled with its repeated plaintive cry in spring and summer. Although you may hear it along forest roads, you will seldom see a whip-poor-will, or its nest. Their cryptic plumage blends easily with tree bark as they roost parallel to the branch. They resemble a lichen-covered knot or bit of dead wood more than a live bird. Their eggs, too, are blotched to resemble the dead leaves of the forest floor among which they lie. Nesting success may depend on this gift of camouflage.

Being night hunters, whip-poor-wills flutter on silent wings over clearings and ungrazed pastures, plucking flies and moths from the air in gaping mouths. Large eyes, giving them acute night vision, glow red when reflecting the headlights of a passing car.

Pileated Woodpecker

Catching a glimpse of a pileated woodpecker is an uncommon but memorable occurrence. This spectacular red-crested bird has a wingspan of 25 to 30 inches. It is amazing that such large, noisy, showy animals could hide in the forest. But this they do, especially in areas of mature deciduous trees. They excavate rectangular nesting cavities, beneath which piles of large wood chips accumulate. Trees that have been invaded by carpenter ants are particularly appealing, the ants being a source of food for wintering birds.

Its large size, conspicuous red crest and large white wing patches belie the fact that the pileated woodpecker is a seldom seen resident of forested areas around the state.

Common Raven, by Randy Rowe. Ravens are rare in Pennsylvania, but they seem to be well established in the more remote mountainous areas here.

WATERFOWL: 1 green-winged teal, 2 American black duck, 3 blue-winged teal, 4 American wigeon, 5 northern pintail, 6 wood duck, 7 mallard (female), 8 mallard (male), 9 Canada goose, 10 tundra swan, 11 northern shoveler, 12 common goldeneye, 13 redhead, 14 canvasback, 15 lesser scaup, 16 ring-necked duck, 17 oldsquaw, 18 bufflehead, 19 white-winged scoter, 20 hooded merganser, 21 common merganser, 22 red-breasted merganser, 23 ruddy duck.

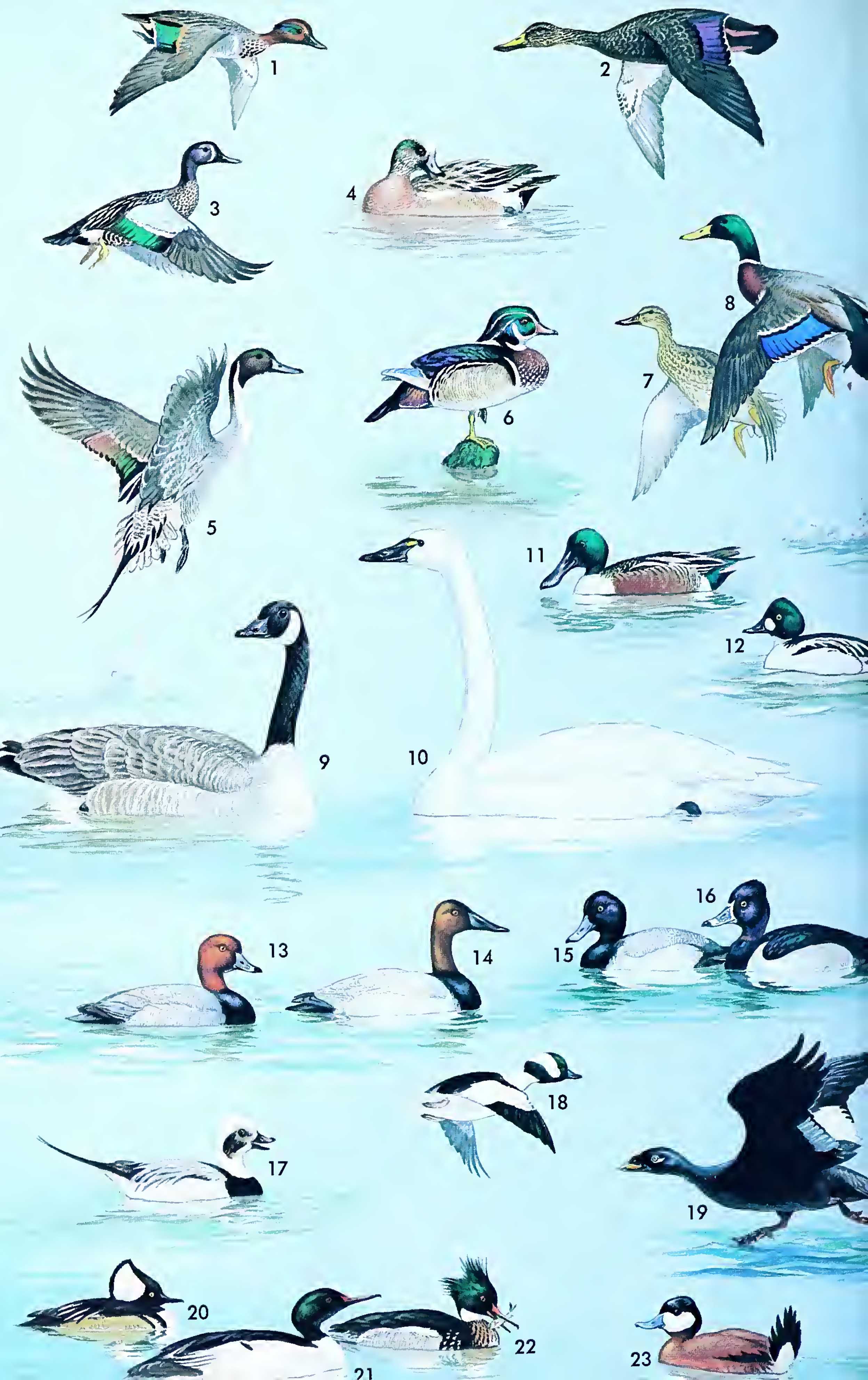
MARSH AND WATER BIRDS: 1 herring gull, 2 ring-billed gull, 3 tree swallow, 4 belted kingfisher, 5 black-crowned night-heron, 6 green heron, 7 great blue heron, 8 American coot, 9 horned grebe, 10 pied-billed grebe, 11 American bittern, 12 great egret, 13 red-winged blackbird, 14 marsh wren, 15 common snipe, 16 lesser yellowlegs, 17 solitary sandpiper, 18 spotted sandpiper, 19 king rail, 20 sora.

BIRDS OF PREY: 1 bald eagle, 2 golden eagle, 3 turkey vulture, 4 great horned owl, 5 merlin, 6 American kestrel, 7 peregrine falcon, 8 osprey, 9 long-eared owl, 10 screech owl (red phase) 11 screech owl (gray phase), 12 saw-whet owl, 13 red-shouldered hawk, 14 barn owl, 15 red-tailed hawk, 16 broad-winged hawk, 17 barred owl, 18 goshawk, 19 sharp-shinned hawk, 20 northern harrier, 21 snowy owl, 22 short-eared owl, 23 Cooper's hawk.

WINTER BIRDS: 1 ruby-crowned kinglet, 2 golden-crowned kinglet, 3 pileated woodpecker, 4 red crossbill, 5 downy woodpecker, 6 hairy woodpecker, 7 pine grosbeak, 8 pine siskin, 9 white-winged crossbill, 10 tufted titmouse, 11 blue jay, 12 brown creeper, 13 black-capped chickadee, 14 purple finch, 15 red-breasted nuthatch, 16 white-breasted nuthatch, 17 starling, 18 evening grosbeak, 19 American crow, 20 northern shrike, 21 northern cardinal, 22 tree sparrow, 23 house sparrow, 24 redpoll, 25 horned lark, 26 snow bunting, 27 white-throated sparrow, 28 dark-eyed junco.

BIRDS OF FIELD AND GARDEN: 1 barn swallow, 2 purple martin, 3 chimney swift, 4 northern oriole, 5 gray catbird, 6 brown thrasher, 7 northern mockingbird, 8 ruby-throated hummingbird, 9 yellow warbler, 10 common grackle, 11 yellow-billed cuckoo, 12 mourning dove, 13 indigo bunting, 14 eastern kingbird, 15 common flicker, 16 American goldfinch, 17 eastern phoebe, 18 yellow-breasted chat, 19 song sparrow, 20 eastern bluebird, 21 house wren, 22 eastern meadowlark, 23 field sparrow, 24 bobolink, 25 common bobwhite, 26 ring-necked pheasant, 27 American robin, 28 chipping sparrow, 29 killdeer, 30 common yellowthroat.

BIRDS OF THE FOREST: 1 rose-breasted grosbeak, 2 red-eyed vireo, 3 black-throated green warbler, 4 northern raven, 5 cedar waxwing, 6 black-throated blue warbler, 7 cerulean warbler, 8 black-and-white warbler, 9 American redstart, 10 yellow-rumped warbler, 11 red-headed woodpecker, 12 great crested flycatcher, 13 magnolia warbler, 14 scarlet tanager, 15 ovenbird, 16 chestnut-sided warbler, 17 hooded warbler, 18 Kentucky warbler, 19 ruffed grouse, 20 hermit thrush, 21 wild turkey, 22 wood thrush, 23 veery, 24 rufous-sided towhee, 25 American woodcock.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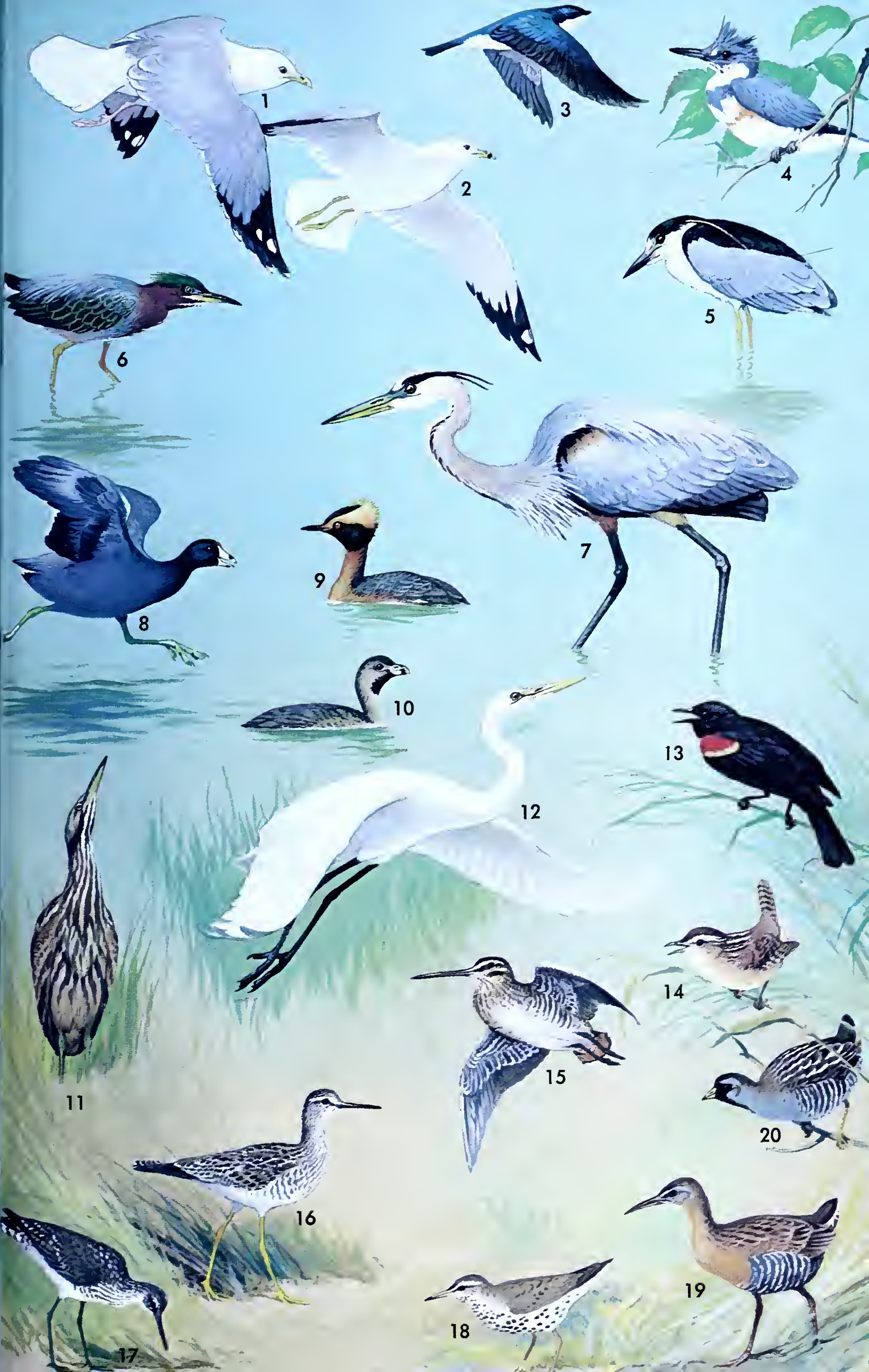
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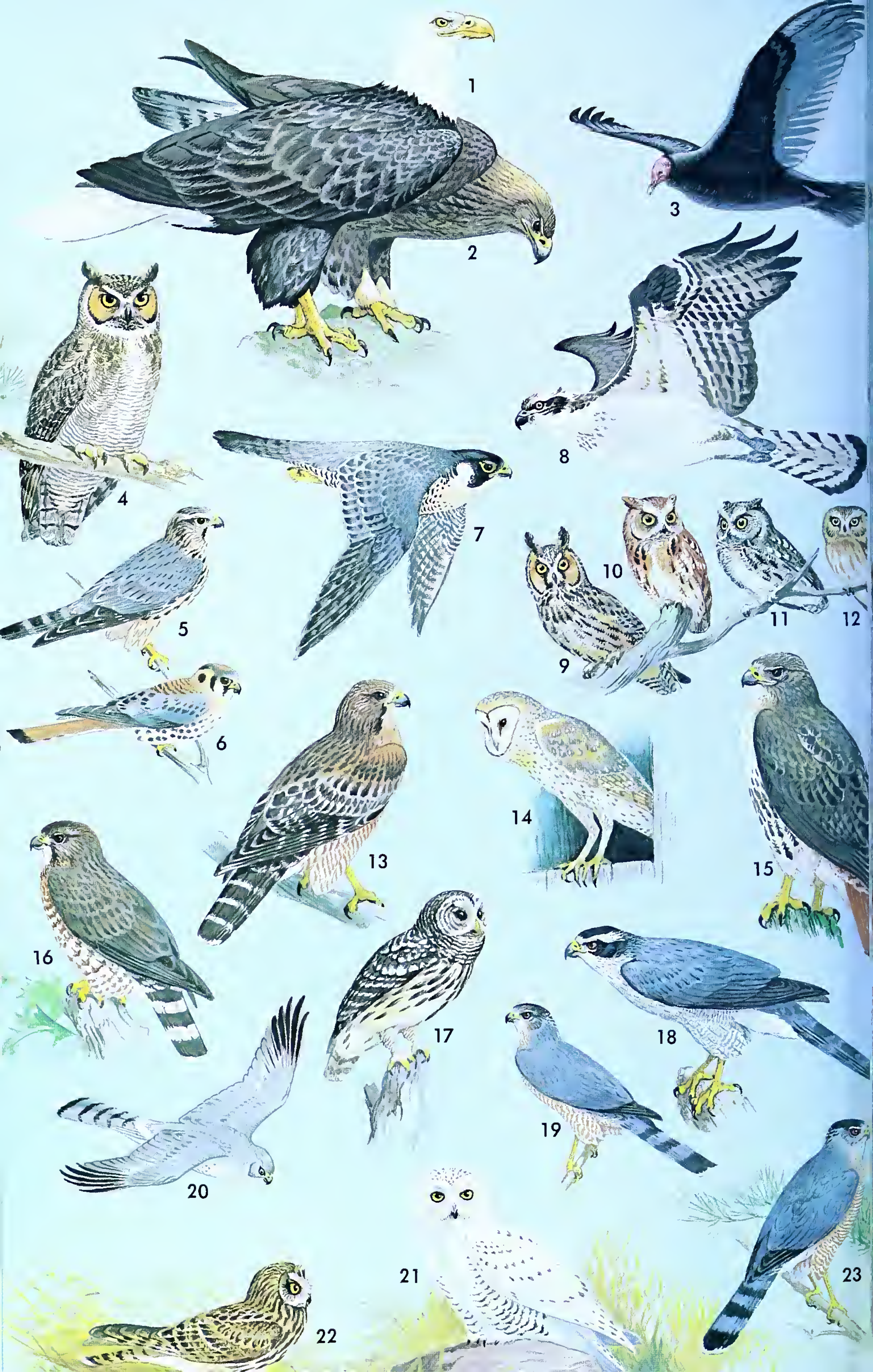
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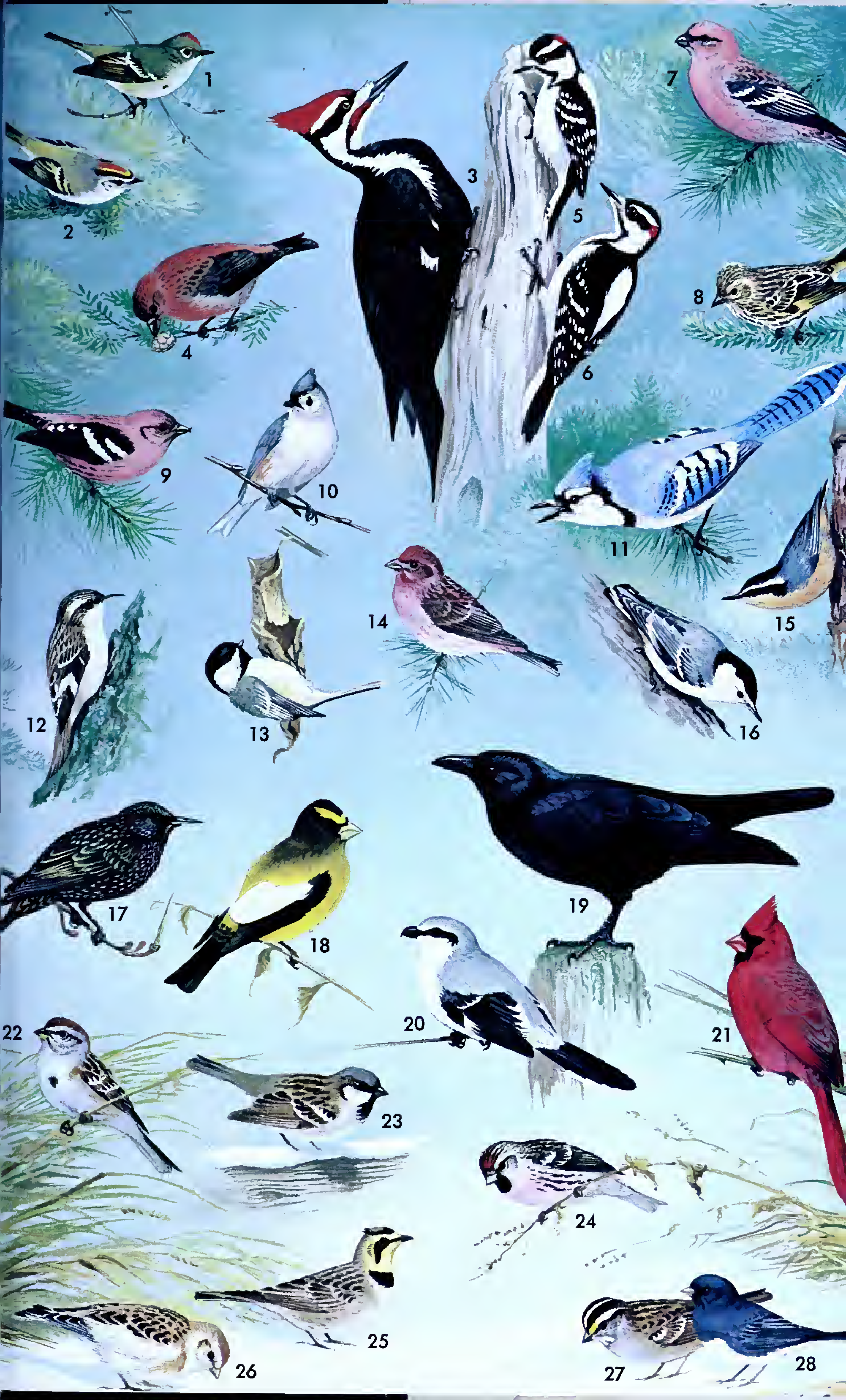
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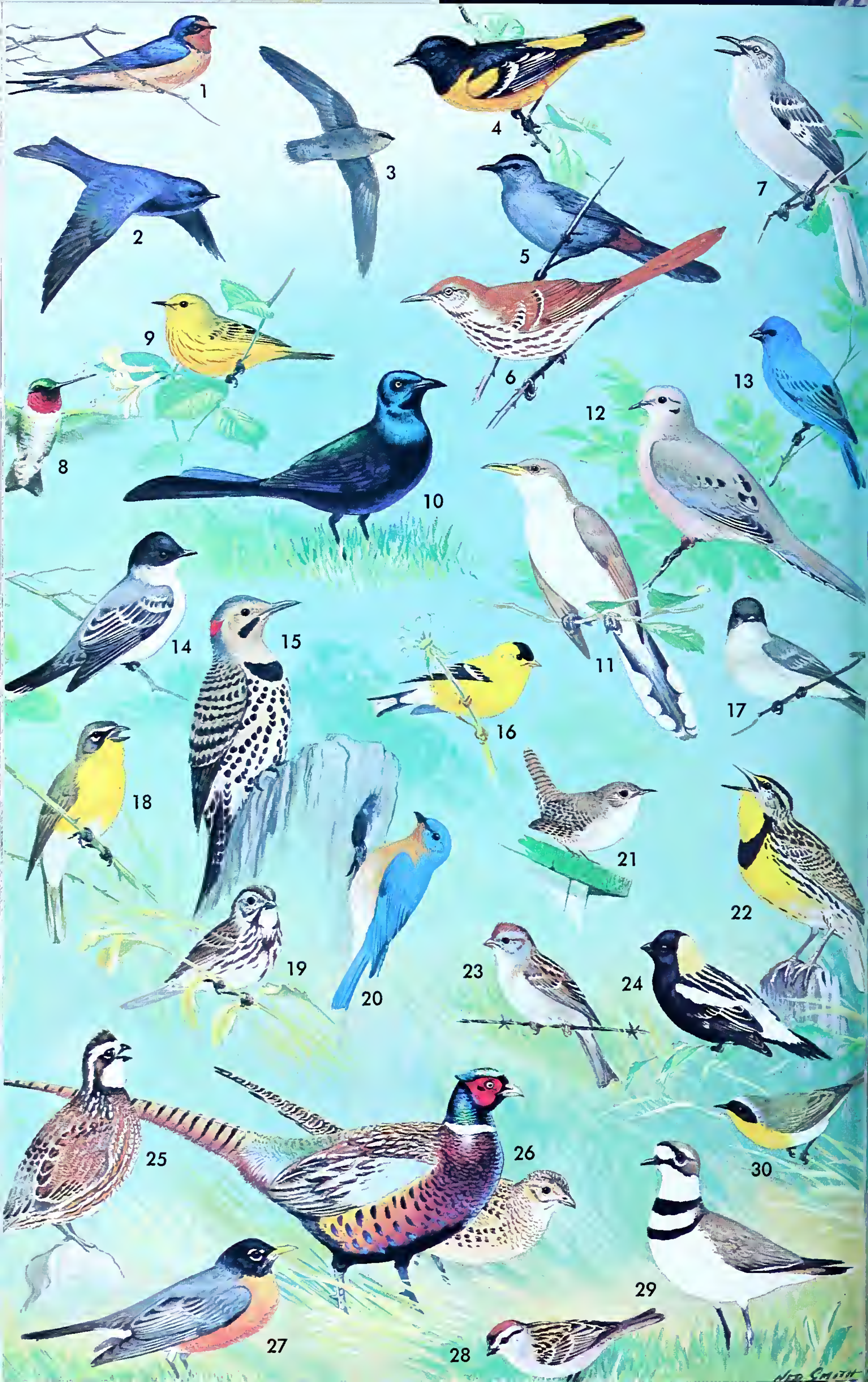
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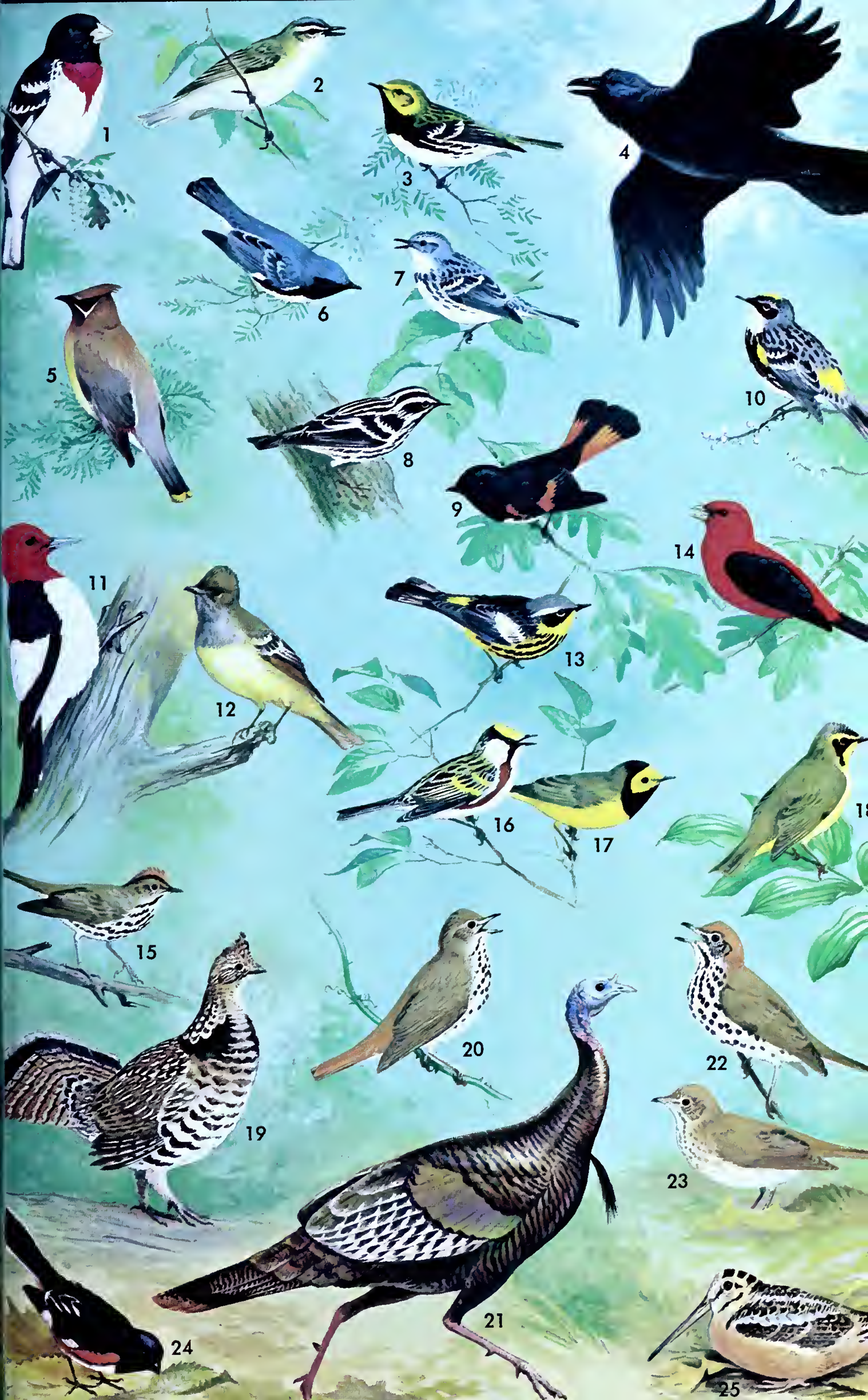
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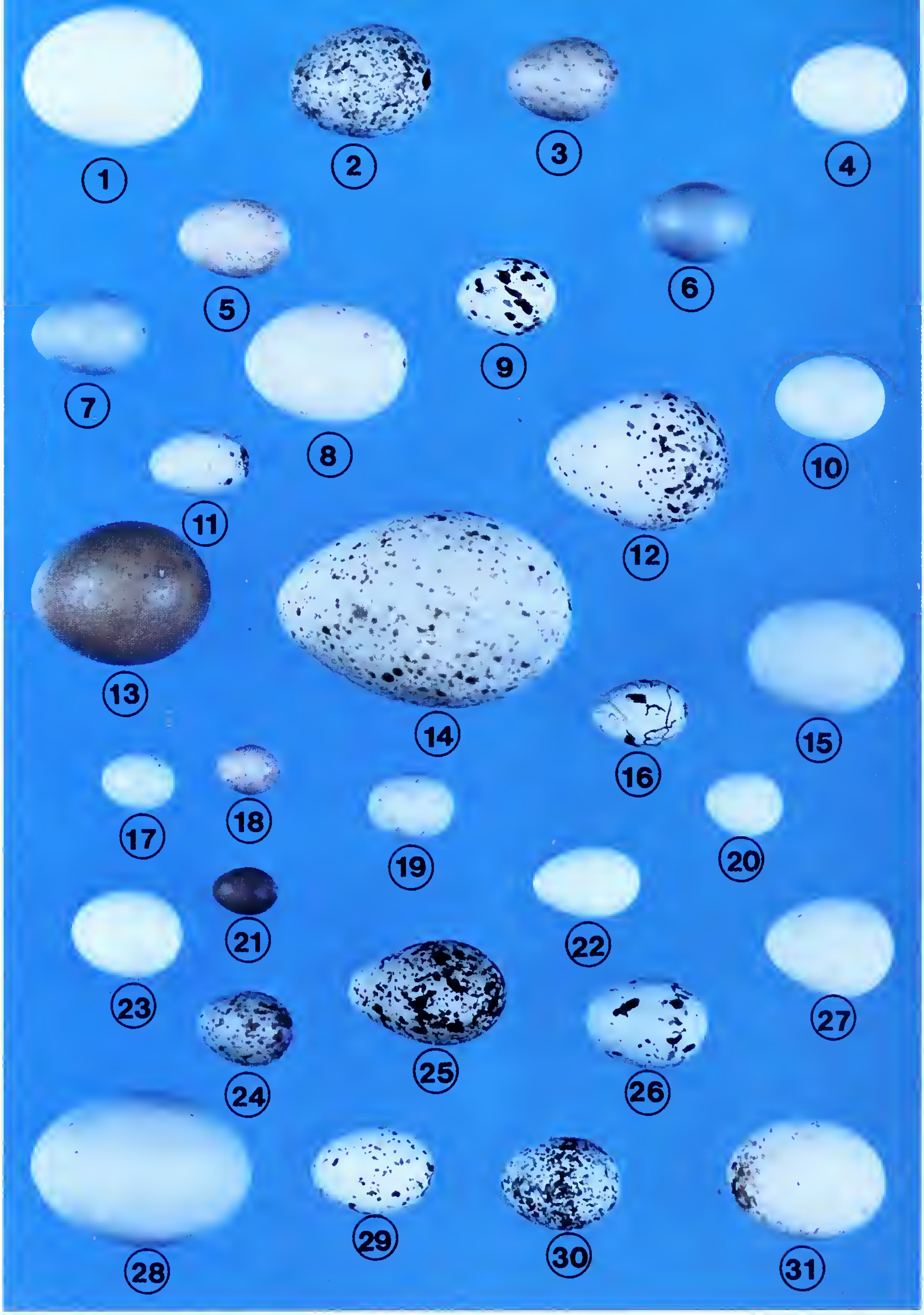


EGG KEY: 1 barn owl, 2 common crow, 3 blue jay, 4 mourning dove, 5 brown thrasher, 6 wood thrush, 7 American robin, 8 ruffed grouse, 9 eastern kingbird, 10 red-headed woodpecker, 11 red-winged blackbird, 12 upland sandpiper, 13 ring-necked pheasant, 14 wild turkey, 15 green heron, 16 northern oriole, 17 purple finch, 18 house wren, 19 eastern bluebird, 20 downy woodpecker, 21 marsh wren, 22 purple martin, 23 common flicker, 24 northern mockingbird, 25 killdeer, 26 common grackle, 27 bobwhite, 28 great egret, 29 eastern meadowlark, 30 common nighthawk, 31 American kestrel.

Photo by Bob Haines

It takes a fairly extensive area of forest to support a pair of nesting pileated woodpeckers. Early in the 19th century, as eastern forests were cleared for farming, these woodpeckers began to disappear. In many regions they were hunted and sold in the cities for food, although by some reports they are tough and nearly inedible. Fortunately for the woodpeckers, second-growth forests began to replace abandoned farms during the 20th century. This provided opportunities for their return, encouraged by legal protection. They are uncommon but year-round residents of Pennsylvania.

Red-bellied Woodpecker

"Red-bellied" seems an odd name for this bird, although it does have a vague reddish patch on its lower front. Red covers the back of its head and neck, but not the entire head — so it couldn't be called "red-headed" woodpecker (a name already given to another bird).

The red-bellied woodpecker, usually considered to be a creature of dense forests, has adapted to wooded suburbs as well. If your land has mature deciduous trees, you may be able to attract this lovely bird to a suet feeder in winter. We have lured one right up to our dining-room window. In the spring he rewards us for our generosity by drumming loudly on the rain gutters at dawn. It is his woodpecker way of claiming our backyard as his territory.

Unlike other woodpeckers, this species prefers berries, acorns, and other vegetable-stuffs to insects. In Florida, they even eat oranges. By having somewhat different diet requirements, several types of woodpeckers can live in one area without excessive competition for food. Thus, ant-eating flickers, insect-eating downy woodpeckers, and the fruit-eating red-bellied species can successfully share a single woodlot or forested neighborhood.

Downy and Hairy Woodpeckers

The downy woodpecker is the smallest and also one of the most commonly seen members of the woodpecker family. Through all seasons, downy woodpeckers inhabit Pennsylvania forests and parks. In winter they flock with other small forest birds, such as chickadees and titmice. They are not shy, and are readily attracted to backyard feeding stations. They share the pattern of their black-and-white plumage with their larger cousin, the hairy woodpecker. These birds are somewhat more secretive, but may venture to your feeding station now and then. Consult a field guide for suggestions about distinguishing between these two species. Once you have identified both, you will probably be able to tell them apart by relative size.

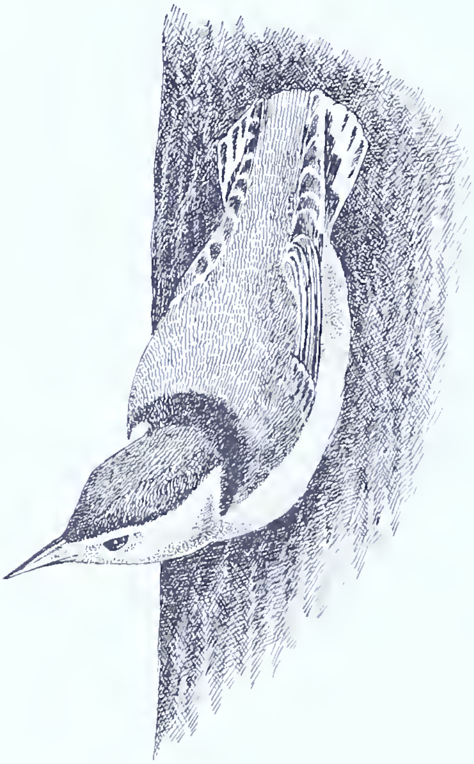
Loud hammering noises are especially impressive from such small birds. The unique skull construction of all woodpeckers allows these little drummers to use their bills to excavate nesting holes in trees. They probe for insects in the crevices of tree bark, catching them with barbed tongues.

Great Crested Flycatcher and Eastern Wood Pewee

These forest birds are similar in many ways to the flycatchers of fields and farms. The pewee looks very much like the eastern phoebe, but it is a bird of the treetops and not usually seen. The plaintive, repeated "pee-ah-wee" song betrays the presence of this inconspicuous woodland resident. Between phrases of song, it may leave its reclusive perch to snatch an insect from the air. Eastern wood pewees also live and nest in Pennsylvania's orchards and forested suburbs.

The great crested flycatcher is a showier bird. It is larger than the pewee and other flycatchers, being nearer robin size. Its yellow underparts and reddish-brown tail and wings are more distinctive than the dull gray hues of its cousins.

Great crested flycatchers nest in natural cavities or nest boxes, to which they may return for many years. Flycatchers are notorious for filling their nesting cavities with bits of trash. Including cast-off snakeskins in their nests is a common practice. Other shiny items, such as bits of cellophane, are favored, too.



The most distinguishing characteristic of the nuthatches is their ability to clamber headfirst down tree trunks — or suet feeders. This, the white-breasted nuthatch, is a common resident here the entire year.

The male maintains a large feeding territory around his chosen nest site. The presence of other male flycatchers is not tolerated during the nesting season. The job of excluding the intruders may entail aerial combat and noisy scolding.

Black-capped Chickadee

Although it is usually considered to be a resident of deciduous forests, the friendly chickadee also lives year-round in Pennsylvania's mixed forests and wooded suburbs. Black-capped chickadees are particularly tame, feeding in the open and sharing winter feeding stations with titmice, nuthatches, and woodpeckers. Because they are present all year, have distinctive field marks and song, and allow close approach by humans, this is among the first songbirds many people learn to recognize and enjoy.

Tufted Titmouse

The small, gray, crested birds at your feeding station in winter are tufted titmice. Their summer diet of insects is often replaced in the cold months by the seeds, bread, and suet provided in wooded suburbs by bird enthusiasts. The titmouse will inhabit the same areas as chickadees and nuthatches, but lack of black coloring and the presence of a crest are distinctive. Like chickadees, these birds occasionally become tame enough to eat from a person's hand. Although they are here year-round, they are best loved for enlivening the winter landscape. If you're used to them as winter birds, their loud whistling spring song may surprise you.

White-breasted Nuthatch

Head down, tail up, the white-breasted nuthatch clings to the bark of trees. Its long, pointed bill is used to probe for insects, or to crack seeds it earlier tucked in crevices as it skipped up and down the trunk. It pauses to survey the area, its neck crooked at an impossible upward angle. Nuthatches are the only tree-clinging birds that move head down, in contrast to creepers and small woodpeckers whose usual posture is upright. White-breasted nuthatches are seen in winter with chickadees, kinglets, and titmice.

Colored in a pattern similar to the chickadee, the nuthatch is readily identified by its upside-down behavior.

Brown Creeper

The brown creeper is a winter resident of Pennsylvania, but may pass through the state during other seasons. This brown-and-white striped bird blends well with the bark of trees, to which it clings as it spirals deftly up the trunks seeking food. Having a long bill, curved downward toward the tip, creepers are well suited to foraging in the cracks and crevices of tree bark. They eat many kinds of insects, their larvae and eggs. Suet or nuts at feeding stations may supplement their winter diet. Their head-up posture and coloring make them easily distinguishable from the other well-known tree clingers, the nuthatches.

Wood Thrush

The thrushes of deciduous forests are physically secretive. You may see them only through diligent searching, but their beautiful songs betray their presence. They are personal favorites of ours, among the most exquisitely melodious of songbirds.

Wood thrushes have adapted to some extent to the presence of man. They may nest and feed in wooded gardens and parks, where they sing from the treetops in April and May. Later in the summer, their activities are limited to the ground and low shrubbery, where they seek insects and berries. Because they often nest near water, wood thrushes are sometimes called "swamp robins." Their affinity for water may lure them from the cover of trees and shrubbery out into the lawn, to "play" in a sprinkler or birdbath.

Veery

The captivating, ethereal song of the veery has been likened to the sounds of flutes or Pan pipes. Although the bird hides in the foliage of treetops or undergrowth, its loud and lovely song punctuates the morning in wooded lowlands and ravines. Like wood thrushes, veerys spend much of their time foraging for fruit and bugs on the forest floor. In spite of their similarities in coloring and habits, veerys and wood thrushes are readily distinguished by their songs. A field guide will help you see other differences among thrushes.

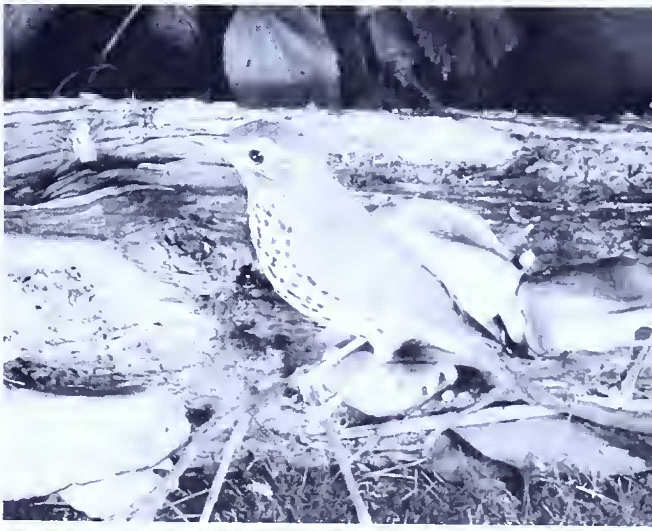
Blue-gray Gnatcatcher

This small active bird, of the same family as the kinglets, is not common in Pennsylvania. Nonetheless, it is sometimes seen nesting at low elevations. Gnatcatchers are always on the move, actively pumping their tails up and down, flitting from tree branches out into midair to catch insects.

The gnatcatcher is a charming little singer. Its coloring is similar to that of the mockingbird, but size and behavior are more like a wren's. Any time of the year, in a secluded forest, you may be treated to a glimpse of him. Look for the distinctive activity and blue-gray and white markings, less than 25 feet above the ground.

Lucky is the person who lives within earshot of the wood thrush. This small forest dweller has what many people consider the most pleasing song among all birds.

Peter & Stephen Maslowski



Vireos

At least five species of vireos nest in the trees of Pennsylvania's forests. The **red-eyed vireo** is one of the most common birds of deciduous woodlands. Nesting pairs sometimes are one per acre during the breeding season (May through July). Retiring by nature and not brightly colored, red-eyed vireos hide easily in the treetops. Their nests are woven hammocks, suspended precariously from low, forked branches.

Walking through the woods on a hot summer day, you are far more likely to hear red-eyed vireos than to see them. The male is so accustomed to being unseen that he sings even from the nest, without fear of betraying its location. His song, endlessly repeated musical phrases, continues during the most sultry weather, throughout the daylight hours, even after nesting has passed.

Warbling vireos are forest birds that have also adapted to life in wooded parks and orchards. They sing through the heat of summer, emitting long, flowing warbles in contrast to the choppy phrases of the red-eyed species. They rarely leave the treetops, where they nest, sing, and feed.

Nesting activities of both of these vireos are taxed by the parasitic habits of cowbirds.

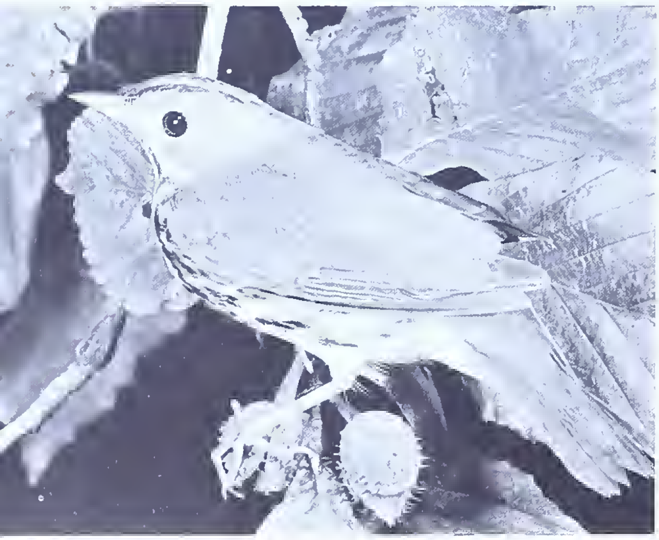
Warblers of Deciduous Forests

The **black-and-white warbler** is among the first of the warblers to appear in spring, up to a month ahead of some other species. Most warblers wait for the hatching of caterpillars and flying insects to insure an ample food supply. Insects and eggs in tiny nooks and cracks of tree bark are adequate for the black-and-white warblers. Their behavior, as they inspect the tree trunk, is similar to that of the brown creeper.

Nestlings do not remain long on the ground after hatching. They quickly gain the ability to pick a safer perch on a tree branch, where their parents continue to feed them. Family groups may remain together throughout summer, foraging quietly in the forest.

Not all warblers require dense brush for feeding and nesting. The **ovenbird** is a creature of the open forest floor. This warbler walks along the ground, using its bill to turn over leaf litter. It is rewarded with an ample supply of grubs, slugs, and insect eggs. Ovenbirds even nest on the ground under forest trees, in the open. Their eggs frequently provide dinner for foxes, skunks, and weasels, but not without a "wounded-bird act" from the female parent as she tries to distract invaders. The ovenbird's beautiful song is easy to identify once you have heard it.

Kentucky warblers have habits much like those of the ovenbird. Most of their activities, both feeding and nesting, are limited to the area less than three feet above the ground. Unlike ovenbirds, though, Kentucky warblers hide their nests neatly in the shrubby vegetation of the understory. They tend to choose damp creek bottoms or wooded upland ravines for nesting and summer living.



The ovenbird is one of the most abundant breeding birds in the state, but it's so inconspicuous it's rarely seen. Birdwatchers familiar with its song, however, will quickly attest to how common this forest warbler actually is.

Peter & Stephen Maslowski

The male **hooded warbler** really does appear to wear a black hood over his yellow head and shoulders. Once you decide from its habitat and behavior that it is a warbler, its coloring is a distinguishing field mark. Hooded warblers choose the forest understory for nesting. They will pluck flying insects from the air, in addition to eating the usual crawling things. They are commonly found in Pennsylvania's rhododendron forests.

Scarlet Tanager

The dense canopy of tall oaks is the usual summer hideaway of scarlet tanagers. Male scarlet tanagers, also known as "firebirds," are brilliant scarlet with solid black wings and tail during the April through June breeding season. But this striking plumage does not make the birds obvious or easy to observe. They feed in the treetops with their yellowish-green mates, retiring and unnoticed, consuming huge quantities of soft-bodied insects.

Pennsylvania is well within the nesting range of scarlet tanagers. Mature deciduous forests, or tall trees in wooded suburbs and parks, attract these birds with ideal nesting sites high above the forest floor. Your best opportunity to see the reclusive tanagers may be during periods of cold spring rain, when they are forced to feed on or near the ground. They visit our birdbath occasionally, teasing us with glimpses of hidden beauty down from the treetops.

Coniferous and Mixed Forests

Some of the forestland of Pennsylvania is comprised of mixed hardwoods and evergreens, or is dominated by coniferous trees. The distribution of forest types is controlled to a great extent by the age of the forest — that is, how close it is to its natural climax of growth — and by soil and topography. The slopes of our forested mountains commonly support some coniferous trees, including spruces, pines, and hemlocks. These, in turn, provide habitat for many species of birds which prefer evergreens for nesting and feeding. Mixed forests also host many types of birds which usually are considered to be residents of hardwoods. And again, some of the birds of this habitat type may dwell in forested suburban areas. Purple finches and pine warblers, among others, commonly are seen in backyards and parks, if the proper mix of trees and shrubs is present.

Goshawk

This rare and reclusive bird usually resides only in northern coniferous forests. Like the loon, the goshawk (pronounced GOSS-hawk) is associated with wilderness and minimal disturbance by man. Nesting has been recorded in several northern Pennsylvania counties, especially where virgin forests remain or where second-growth conifers have attained a large size. Most sightings occur during fall and winter.

The broad wings and long striped tail of the goshawk permit perfect control in forest flight. It is amazing that such a large bird, with a wingspread of four feet, can hide in the forest and fly easily through the dense canopy. The larger female dominates a breeding pair. She incubates and feeds the young, and is more ferocious in defense of eggs or offspring. For centuries, female goshawks have been prized by falconers, and trained for the hunt.

Sharp-shinned Hawk

Year-round, the sharp-shinned hawk lives in Pennsylvania's remote forests. This small (10 to 14 inches) long-tailed hawk may move through or to any suitable habitat during migration and winter.

One winter, a young "sharpy" took up residence in our neighborhood. She apparently had discovered that flocks of small birds, including large numbers of starlings and house sparrows, frequented feeding stations in nearly every forested backyard. The snowy clearing near our house provided her a view of the potential meals flitting about near the ground. Whenever the hawk was on the wing, the usually hyperactive downy woodpeckers froze in place. They could more easily evade the hawk's keen eye if they looked like lumps on the tree bark. Other birds scattered, diving for protective cover.

The sharp-shin's hunting dive was swift and sure, down from the treetops, feet first with wings partly folded, snatching a starling from the air. On one occasion, her grasp was insufficient to kill, and the shaken starling escaped. Other times, we returned home to find a pile of feathers on the icy patio, where the hawk had plucked her meal.

Merlin

This small, uncommon falcon is not often seen by casual observers. During the peak of the fall hawk migration, in late September and early October, merlins fly daily over Kittatinny Ridge at the Hawk Mountain Sanctuary. At other times, even though they nest and winter within Pennsylvania, merlins manage to hide successfully in mixed forests, feeding on songbirds and upland gamebirds.

Historically, merlins were a ladies' bird for falconry, probably because their diminutive size (around one foot long) made them a reasonably comfortable passenger on the arm of the royal horsewoman.

The saw-whet is the state's smallest owl and it is also the most rare. When it is encountered, it's most often found while roosting in coniferous plantations.

Northern Saw-whet Owl

The call of this very small owl was thought by early observers to resemble the sound made by whetting or sharpening a large mill saw. The name "saw-whet" stuck, and by this name it is still known, even though few sawmills remain in modern forests and fewer people remember the historic sound. These owls limit their vocalizations to a few weeks in the spring, their voices staying as silent as their flight for most of the year. Saw-whet owls usually prefer coniferous forests, roosting on perches or hiding in holes in hemlocks or pines during the daylight hours. Young owls hatch into the confines of re-used flicker holes. Their attentive parents hunt all night for insects, and occasionally small mice or birds, to feed the hungry youngsters.

Great Horned Owl

The familiar great horned is the owl most people picture first when they think of owls. Its horns are not the ears they appear to be. The ears, like those of most owls, are openings in the sides of the heads, surrounded by special soft feathers that funnel the sound. This owl's hearing is extraordinary, and helps it locate prey it cannot see even with its huge eyes and acute night vision.

In Pennsylvania and over much of the U.S., great horned owls are year-round residents, although some individuals move southward from northern Canada for the winter. During the day they roost quietly in the dark protection of tall evergreen trees. At dusk they move to more open perches, to begin their hunting vigil. Some pairs hunt and nest successfully near farms or in wooded suburbs in the summer. We see one at dusk several times each June, perched in the dead top of a huge oak tree in a wooded lot. Its large size and distinctive "horned" profile provide identification, which is confirmed by the familiar "hooting" call.

Like barn owls, the great horned is silent on the wing, swooping noiselessly down to catch almost any small animal in powerful taloned feet. Chipmunks and skunks, water birds, frogs — almost anything—might be caught, torn into small pieces, and eaten bones and all. The indigestible parts are regurgitated periodically. Scientists study these bony pellets coughed up by owls (and by hawks as well) to determine which animals are favorite food items.

Great horned owls nest in many secluded places. A hollow tree, cliff ledge, or the abandoned nest of a hawk or heron becomes home with a new lining of feathers. They nest very early, sometimes incubating their eggs through late snows. The parents are fearless if the nest is threatened, and have attacked and injured people who attempted to approach too close. Their raking talons are formidable defensive weapons.

Long-eared Owl

The long-eared owl is relatively slender among owls, with elegant, long wings. Its wingspan may be three times its body length. This secretive, truly nocturnal bird hides effectively in pine and cedar forests during daylight. Standing upright with compressed feathers, it is disguised as a tree branch. Its "long ears" are feather tufts which are folded back during flight, and are far less obvious than the "horns" of the great horned owl.

Long-eared owls are residents of Pennsylvania in all seasons, although the same individuals do not necessarily remain year-round. Those pairs that nest here choose the abandoned but pre-built homes of squirrels or crows high above the ground. The nesting season is the only time of year they are noisy. If the nest is threatened, they protest with blood-curdling screams and strangely anguished cries, and may use a stylized crippled-bird act to entice an invader away from their young. They rarely resort to physical force.

Common Raven

The raven is North America's largest "songbird," and the largest solid black bird in Pennsylvania. Ravens are not really common here, having moved back into our forested mountains only recently. They are soaring birds, able to ride thermal currents effortlessly, buoyed up by a wingspan of four feet or more.

Ravens are believed to mate for life. For nesting, they carefully select a sheltered ledge on a cliff face, accessible only to those with wings. Tall coniferous trees may also serve this purpose. The forested ridges of north-central Pennsylvania provide the best raven habitat in the state. Several prominent cliffs in this region are renowned "ravens' roosts."

Yellow-bellied Flycatcher

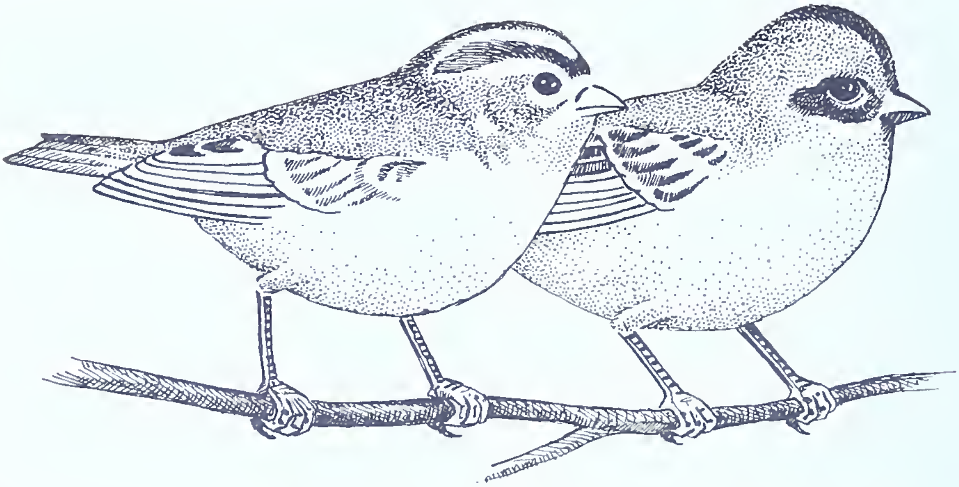
The great horned owl is one of the most formidable avian predators. There's not much in the smaller animal world that this owl can't or won't prey upon.

Leonard Lee Rue

The northern spruce forests and Pocono Mountains are usually the only areas of Pennsylvania to host nesting yellow-bellied flycatchers. This bird is smaller than the great crested flycatcher of deciduous woodlands. Its throat and chest are washed with yellow, although you may never see it clearly enough to notice this. Unlike its treetop cousins, this flycatcher nests on or near the ground, hiding in the damp undergrowth, and catching ants and beetles. Habitat and voice may be the best clues for distinguishing among the flycatchers.

Red-breasted Nuthatch

The red-breasted nuthatch is usually a winter resident of Pennsylvania's evergreen forests. This is a smaller bird than its white-breasted cousin, with distinctive rusty underparts and white facial markings. Its bill is specialized for picking the seeds from spruce and pine cones, although it eats insects, too. It is not seen as frequently as are white-breasted nuthatches, nor drawn as readily to feeders, although it has the same upside-down habit.



Kinglets, the golden-crowned, left, and the ruby-crowned, are among the smallest birds in the state and can easily go unnoticed. They are most often seen in migrating flocks with chickadees, nuthatches and brown creepers.

Swainson's Thrush

This thrush prefers mature coniferous forests and mixed brushy woodlands. Swainson's thrushes have the usual buffy-brown back and spotted breast of other thrushes (see wood thrush, veery). They feed on insects and berries, foraging near the ground, in shrubbery, or in treetops. The song of the Swainson's thrush is distinctive and captivating, a rising series of breathy, flutelike whistles, declared from the treetops.

Swainson's thrushes migrate at night, and many are killed colliding with man-made towers. In Pennsylvania, this bird's breeding activities are usually limited to the forests of the northern counties.

Kinglets

Two species of kinglets, the **golden-crowned** and the **ruby-crowned kinglets,** are spring and fall migrants throughout Pennsylvania. The golden-crowned species will nest in mountain areas. In winter, these tiny active birds flock together with the creepers and chickadees of mixed forests and parks, enlivening the cold landscape.

The ruby-crowned kinglet has a loud, musical song, which far outsizes its diminutive stature. We seldom hear it burst forth in song, because it nests even farther north than the golden-crowned species. But the ruby-crowned kinglet is more common as a migrant and winter resident in thickets and hedges. It hovers nervously at the tips of twigs and among fallen leaves, seeking many types of insects and seeds to support its seemingly endless activity.

Solitary Vireo

The undergrowth of mixed forests boasts the best nesting sites for solitary vireos. These tuneful but reclusive birds shun the parks and gardens of man. They prefer to nest in the shrubs of forest clearings, catching insects in nearby treetops. As with other vireos (see in Deciduous Forests), the sweet, high-pitched song of the solitary betrays its presence. These inauspicious birds have been known to remain remarkably calm during human visits to their nests. Some observers have even handled and fed adult birds during the incubation period. Handling wild birds is not recommended, however.

Warblers of Coniferous and Mixed Forests

Decked out in black, blue-gray, and white with bright yellow accents, the

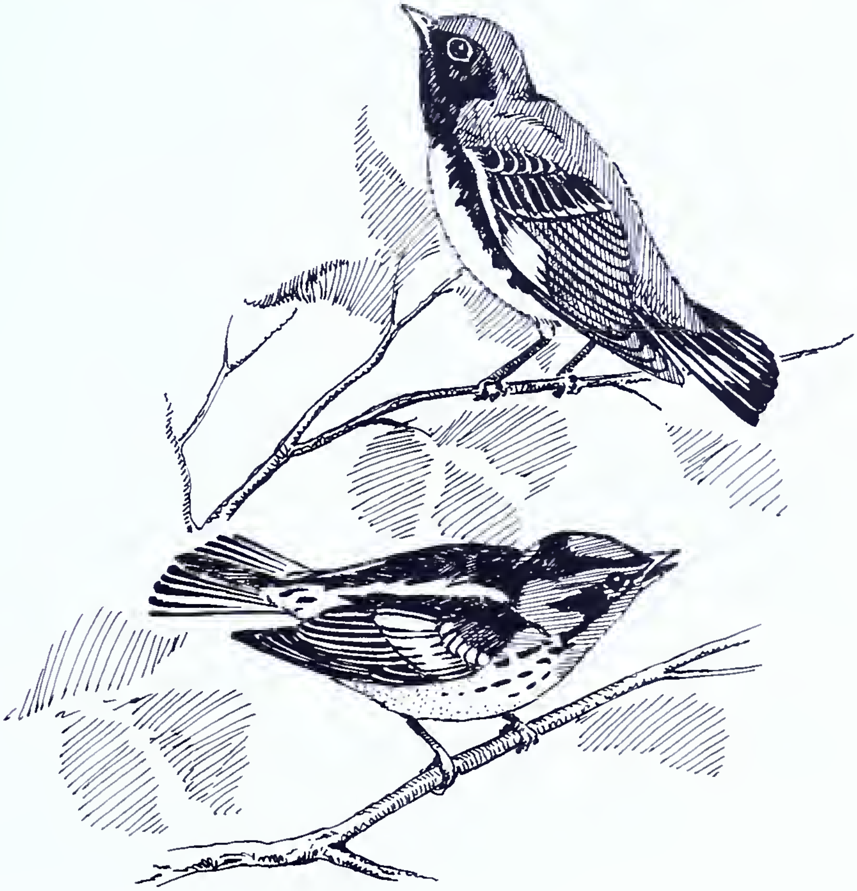
magnolia warbler has striking plumage. This active insect-eating bird nests in northern coniferous forests. The male flits tirelessly about in evergreen thickets, singing musically. Like many other warblers, magnolia warblers traverse Pennsylvania during migration, and sometimes nest here, but winter in Central and South America.

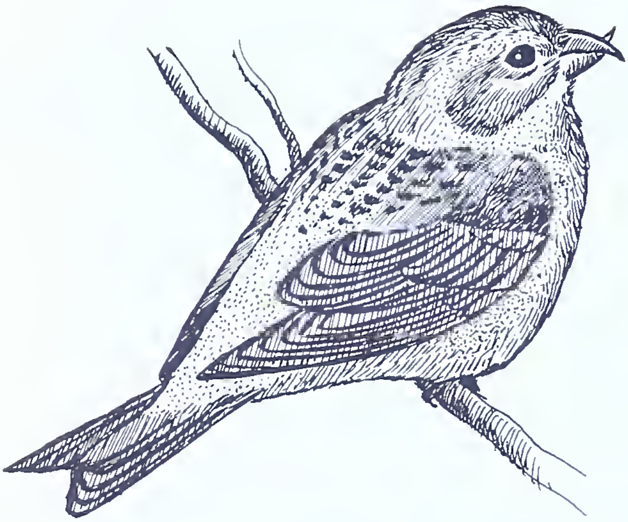
Yellow-rumped warblers (formerly called myrtle warblers) are among the best known and most numerous of wood warblers. They migrate among the early waves of northward-moving warblers in spring, flitting through leafless treetops when they pause to feed. Females join the males in northern nesting territories a few weeks later. They nest occasionally in Pennsylvania's spruce bogs and coniferous woods, but usually nest in Canada and Alaska. Among the last to leave the nesting areas, some eastern yellow-rumped warblers winter in Panama. Others go no farther south than coastal Oregon or New Jersey. Some years, a small number spends the winter in Pennsylvania.

A dark, blue-gray back, black face and throat, and white chest characterize the male **black-throated blue warbler.** As with many small warblers, the female is more neutrally feathered. These birds inhabit Appalachian evergreen forests. Large groups pass through the coniferous woods and park groves of Pennsylvania every spring. They commonly nest on individual territories in spruce and rhododendron forests.

May brings the sweet trilling of warblers, causing birdwatchers to scan the treetops and develop an ailment known as "warbler neck." The **Blackburnian warbler** is a notorious

Both the black-throated blue, above, and the Blackburnian warblers are common migrants through the state. Early to mid May, before the trees have leafed out, is the best time for observating these and other migrating warblers.





Crossbills are named for their unique bills which are adapted especially for removing the seeds from pine cones. The red crossbill, illustrated here, has reportedly nested in northern Pennsylvania.

offender, prompting people to kink their necks at spine-cracking angles to identify the source of the song. If you are lucky, you will see the fiery orange throat of this colorful little warbler as he darts among the tops of tall hemlocks. We have seen them quite clearly, picking caterpillars from the tips of nearly defoliated oak branches. The rain stops their song, sending them flitting off to more protective cover.

Pine warblers also are birds of the treetops. They migrate northward early, and may already have nests and eggs before the redstarts and magnolia warblers appear. The well-kept groves of pines and spruces on state campgrounds and college campuses provide ideal habitat for this lovely gray-green and buffy-yellow bird. Immature birds and adults during fall migration are brown, with no trace of yellow.

Purple Finch

Not actually "purple," male purple finches resemble heavy-billed sparrows with widespread raspberry coloring. They are renowned for their enthusiastic courtship ritual, during which the male finch may dance around the brownish streaked female, fluttering his wings fast enough to blur. Tall spruces, pines, and firs of open coniferous woodlands host the nesting activities of purple finches. Here, dense evergreen foliage provides their preferred nesting cover, and support for complexly woven nests. Although they are not usually city dwellers, they can be seen in suburbs and parks, and along country roads. The physical contrast between house and purple finches is best observed when they flock together at winter feeding stations.

Pine Siskin

This fairly drab winter resident lacks distinctive coloring. Fine, all-over streaking and a thin, very pointed bill are the best field marks. Siskins have seed-eating habits similar to those of redpolls (both are in the finch family). Individual siskins fly fairly high and rapidly. So the best opportunity for people to see them is when they are flocked for feeding, at times with goldfinches, redpolls, and crossbills. Noisy, foraging flocks repeatedly break up and reform, as the birds seem to flow through the bushes and trees.

Crossbills

Crossbills are considered to be rare winter residents of Pennsylvania. Occasionally, however, large flocks of either **white-winged** or **red crossbills** invade the state. They may range this far south in years of overpopulation or food shortage.

Their peculiar crossed bills are uniquely suited to prying open seeds from the cones of evergreens. Red crossbills split the seed cases with a lateral motion of their beaks, then flick the seeds out with their tongues. Calcium chloride, used to melt snow, may lure them to roadways.

Red crossbills have been known to nest in northern Pennsylvania, their usual range being more southerly than that of the white-winged species.

Marshes

Wetlands are well known as being productive areas for wildlife, especially birds, because they provide rich, diverse habitat. Both underwater and emergent vegetation are present, meeting the feeding and cover requirements of many species of birds. The Pymatuning Waterfowl Area, in Crawford County, is possibly our best known wetland. Every year, thousands of birds use this area for resting and feeding during migration periods. It also provides nesting sites for some of them. Another important wetland area in Pennsylvania is the Tinicum National Environmental Center, near Philadelphia.

The birds described in this section are primarily marsh dwellers, usually feeding and nesting in or near shallow water. Many other species of birds may be present in marshy areas, depending on the surrounding habitat types.

Pied-billed Grebe

Marshes and lake margins throughout much of the continent are inhabited by pied-billed grebes. Being reclusive birds, each pair nests singly, and although they are fairly common, they are inconspicuous. Grebes are perfectly adapted to life in and on shallow water. They fly well enough to migrate, but they are built for swimming and diving. Short wings, very short tails, and legs located far back under their bodies are specialized for submarine travel. Like the loon, the pied-billed grebe can submerge slowly, partly "deflating" itself, so that only eyes and the upper bill protrude above the water in periscope fashion. Their feet are partly webbed, giving great power with each back stroke, and folding on the forward stroke to decrease resistance.

Pied-billed grebes build their nests over water, of and anchored to grasses and rushes. The young get a free ride on their parents' backs, clinging skillfully even during shallow dives for food. Adults and chicks thrive on the bounty of the shallows: water insects, crawdads, and small fishes.

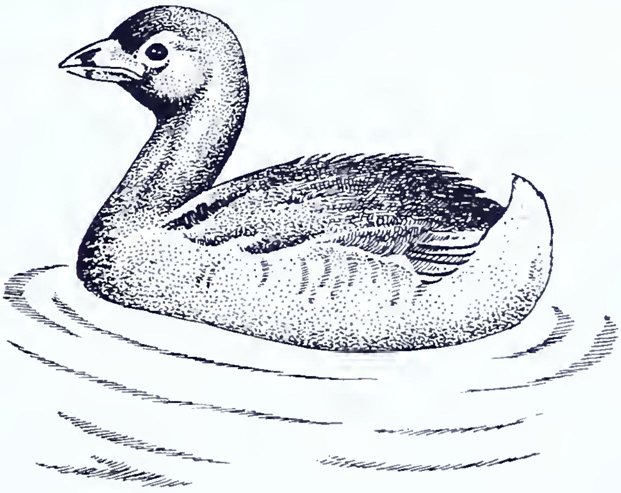
The transition from water to air requires unusual effort. They must run over the water for long distances, flapping their stubby wings and trying to push off with their feet. Because of the aft positioning of their legs, they travel slowly and laboriously on land, and usually cannot take off from ice or turf.

Snow Goose

Pairs or small flocks of snow geese occasionally stray into Pennsylvania during spring or fall migration. They are large, heavy-bodied birds, with a wingspan up to five feet, but are readily distinguished from swans by a much shorter neck. They may land in newly sprouted fields to graze on fresh shoots.

Ducks of Marshes

Of the two major tribes of ducks, surface-feeding ducks and diving ducks, those that eat what they can



The pied-billed grebe is most often seen here during migrations, but they may be found nesting in suitable habitat around the state.

reach from the water's surface tend to prefer marshy areas with shallow water. Several of the surface-feeding ducks thus are associated with marshland habitat and are described here.

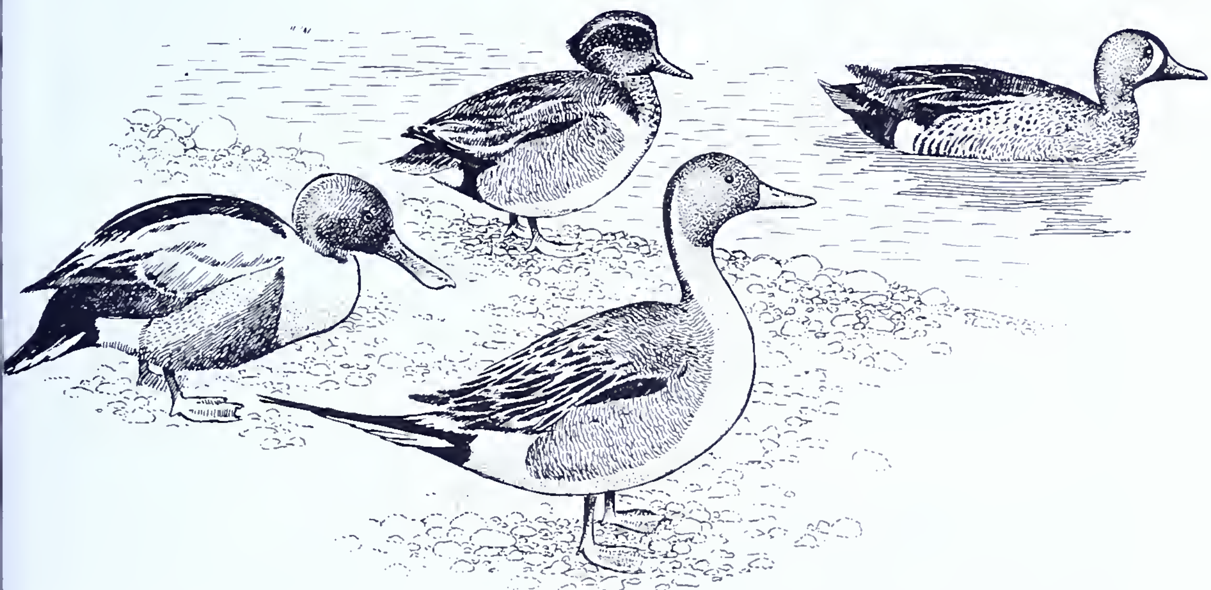
Surface-feeding, or dabbling, ducks in general are able to utilize smaller and shallower bodies of water than are the divers. The proportioning of their wings permits them to leap into the air and into flight, almost like small helicopters. They fly fairly slowly, giving them landing ability in tight places, such as small marshy ponds surrounded by large trees. With legs positioned forward under their bodies, they can locomote on land, although the wide spacing of their lower limbs makes them walk with a waddle. They may graze on new shoots in fields, or consume waste grain. Seeds of many types of plants are favorite fare. The dabbling ducks tip forward with only their skyward-pointing tails out of water to feed on submerged pondweeds.

For most of the year, male dabbling ducks are brightly colored, with patches of blue, green, red, or white on wings and head. During spring and fall migration, the only times most of these birds are likely to be in Pennsylvania, their showy plumage helps people identify them. The short period of molting, during late summer, renders them flightless while new feathers grow.

Northern pintails are among the most widespread and numerous of marsh ducks. Slim bodies and wings make them excellent flyers. Their "pin tails" are especially long feathers at the center of the tail. On take offs, the tail is straight back for balance. Floating high in the water, the long-necked and white-breasted pintails resemble elegant sailing ships.

Gadwalls are not brilliantly colored, although their wings flash distinctive white patches in flight. Swimming on the water's surface, both sexes might be mistaken for female mallards. A large population of gadwalls survive the winter's cold on and around Chesapeake Bay. Their migration corridors cross Pennsylvania. Strong walkers, gadwalls may wander into lowland forests and fields in search of grain and acorns.

Brilliant green patches on wings and head characterize the drake **American wigeon.** His white crown gave him the nickname "baldpate." Unlike other dabblers, wigeons choose the stems



Four dabbling ducks commonly seen in Pennsylvania are the northern shoveller and the northern pintail, front, and the green-winged and blue-winged teal, in back.

and leaves of aquatic plants, and may graze on clover and grass stems when landward. Migrating birds may land in mixed flocks with diving ducks, from which they steal deep-water plants, or feed in the fields with mallards.

The **northern shoveler** was named for its broad, shovel-like bill, a specialized piece of feeding equipment. Comb-like projections along the edges of both mandibles, present in all surface-feeding ducks, are particularly large and effective for shovelers. They can strain small bits of animal life from the murky water they kick up in the shallows. At other times, they are true "surface feeders," paddling along with their heads and bills partly submerged, filtering sustenance continuously. Shovelers physically resemble mallards, but hunters consider their flavor inferior, possibly due to the shoveler's muddy diet. They are jokingly called "neighbors' mallards," suggesting that a hunter would give them to his neighbor rather than eat them himself.

Blue-winged teal and **green-winged teal** are among the smallest of the ducks that migrate through Pennsylvania. Characteristic patches of color on wing feathers, for which the birds are named, differentiate the drakes of these two species. The hens are nearly indistinguishable.

Blue-winged teal nest occasionally in the larger wetlands of Pennsylvania. Tall grasses conceal their clutches on dry land near bogs or swamps. The hatchlings quickly learn for themselves to find seeds of water plants, small insects, and mollusks. Green-winged teal very rarely nest here. The first snowy weather in the north sends the signal for green-wings to migrate. Along the way, they may join with some of their blue-winged cousins in small, swift flocks.

Northern Harrier

The harriers, or "marsh hawks," are large hawks of fields, marshy meadows, and open wetlands. Flying a few feet above the ground, they hunt on the wing rather than from a perch, for rodents, small birds, frogs, and other small animals of pastures and bogs. Their low and hovering flight pattern, of irregular flapping interspersed with short glides, is fairly characteristic of the species. They are also reputed to have a more acute sense of hearing than other hawks.

Harriers dwell in Pennsylvania year-round, more abundantly during the nesting season. Unlike other large hawks, they require no cliffs or tall dead trees for supporting their nests. The ground will do, or low wetland brush, where the darker colored female collects a pile of dry twigs and grasses. The female also incubates the eggs for about a month, and young birds require another month of rapid growth in preparation for fledging.

Great Egret

In Pennsylvania, the heron family is represented by egrets, herons, and bitterns. These birds are usually seen only as they wade ponds and swamps, or fly to and from them. The great egret is a magnificent solid white bird of statuesque height, approaching three feet or so. It is not a common nesting bird this far north, but some will produce and raise their families in the southeastern counties, especially in the Tinicum marsh, where they also rarely winter. Like its large, long-necked cousins, the stately egret effectively shortens its neck during flight, kinking it into an S-curve to avoid imbalance.

During the early 1900s, the beautiful breeding plumes of the imposing egrets nearly caused their extinction. The specialized back feathers of nesting birds were prized as adornments for ladies' hats. Shooting the birds was the only way to get the feathers in perfect condition. After the breeding season, the worn plumes are often shed into the water, ruined and gone. Market value per ounce of egret plumes was for awhile twice that of gold. Strict protective measures were enforced just in time, and populations began increasing. And, fortunately, fashion trended in other directions.

Great egrets nest on carelessly built stick platforms over the water or in treetops. Small fish and frogs, which they skillfully snap up with long, thin, pointed beaks, furnish a ready meal. They don't spear their food, but grasp it and swallow it whole. Their growing youngsters eagerly demand the provender second hand, and the parent birds regurgitate a nourishing slurry on demand.

Great Blue Heron

The great blue herons are probably the largest birds you will ever see in Pennsylvania. Standing as much as four feet tall, and spreading their blue-gray wings to span seven feet, they certainly deserve being called "great." Migration routes for these stately creatures cross Pennsylvania. Many herons remain to nest, in ponds and lakeside marshes. A single huge tree may underpin the flimsy stick platforms of a whole colony of nesting birds.

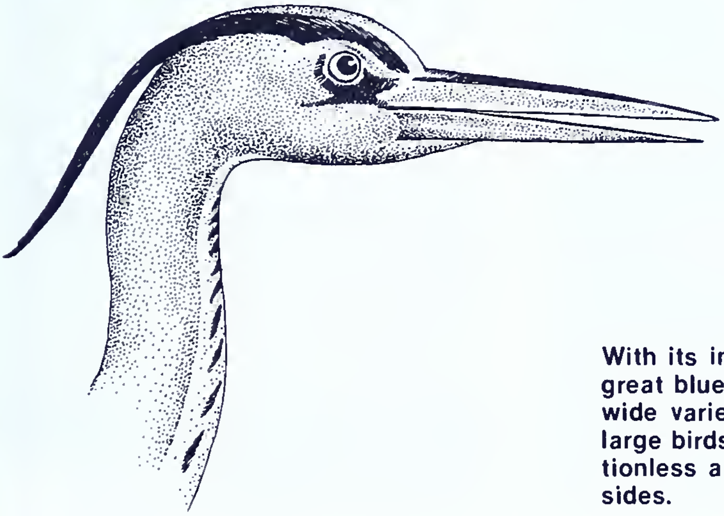
Fishing for its dinner, a lone great blue heron will stand motionless in the shallows. It walks carefully and slowly, searching for small animals in the water. So gracefully does the heron lift its foot from the water, the surface is hardly disturbed, and the prey rarely warned of its peril. Perhaps the heron's long stilt legs just look like reeds to the fishes and frogs it seeks.

With a quick, stabbing motion, it impales larger meals; smaller delicacies are grasped underwater between spear-like mandibles. To consume its prize, the heron triumphantly tosses the morsel into the air, to catch it skillfully and swallow it whole. If it has young at home, the partly digested tidbit may be regurgitated later for their nourishment.

After supper, the huge blue-gray heron launches itself into the air, dangling legs and long neck pumping in synchrony with its broad, slow wingbeats. Once airborne, it tucks its long trailing legs tightly against its body, and folds its neck into the S-curve that characterizes the heron family.

Green-backed Heron

This midget member of the heron family is not really green, but its unremarkable brownish plumage is tinged with gray-green and blue. Standing only about a foot tall, this heron is common throughout much of eastern North America. It graces ponds, streams, and marshes during migration and breeding. Stalking its dinner along water margins, this small bird stands and hunts by much the same quiet-but-sure methods used by



With its impressive dagger-like bill, the great blue heron is able to feed upon a wide variety of small creatures. These large birds are often seen standing motionless along lake shores and streamsides.

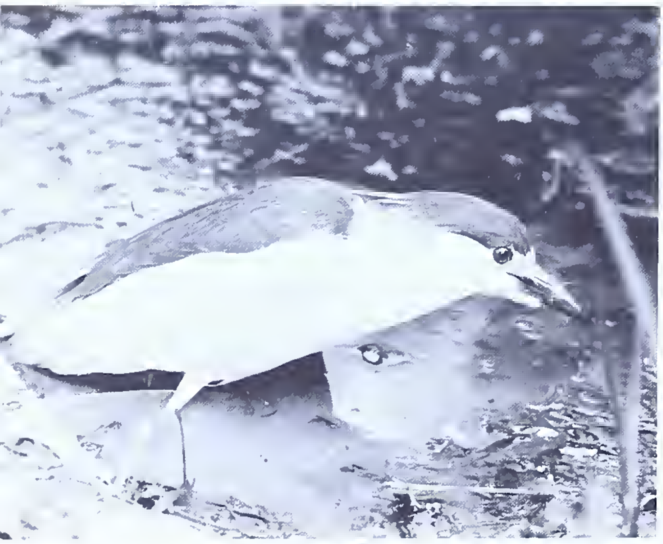
its great blue cousins. Cat-like stealth such as this is impressive from a short, broad-bodied bird. It may choose to dive for the next meal, and in fact can swim underwater with ease.

Diminutive size and unassuming plumage permit these skilled fishermen to blend in with their surroundings. They nest unobtrusively in tangled shrubbery near or over water. If startled, they will return the favor, and take off up the creek crying raucously at the intruder.

Black-crowned Night Heron

This gray-and-white bird is black-backed as well as black-crowned. Roosting by day, perched in thickets and trees on its short legs, this heron's penchant for dining "fashionably late" influenced its name. Its heavier bill allows it to catch and consume all manner of small animals — fish, frogs, snakes, small birds, squid and crabs if it lives on the coast. An adaptable appetite grants a varied food supply — whatever is "in season" is probably adequate.

Young night herons quickly grow into the habit of demanding solid food. Parents return to the reed nest in tall trees or alder thickets, bringing the latest catch to their clamoring nestlings. The brown-streaked youngsters greedily attempt to swallow dinner whole as their parents do. But the tail of a large fish or snake may protrude from their beaks for hours, until the head is digested and swallowing resumes. Their short-necked build has its drawbacks.



The contrasting blacks, whites and grays on the black-crowned night heron give it a dignified appearance. This heron is most likely to be seen in Pennsylvania during spring and fall migrations.

American Bittern

The American bittern is a solitary resident of bullrushes and cattails. It spends its life amid the plants of shallow water; roosting in trees is left to the other members of the heron family.

A bittern's behavior enables it to blend unnoticed into the marsh. Standing erect, it points its beak skyward, all of its brown and white streaking held vertically like the reeds and grasses. With eyes positioned low on its head, it can look frontward even while its bill aims upward. This ocular arrangement also permits it to hold its head parallel to the water's surface in a seemingly disinterested fashion, while peering avidly downward for potential prey. Anything on or under the water is likely to be consumed.

A distinctive, guttural, pumping "song" calls attention to courting bitterns. The sound results from a stylized air-gulping belch, and may carry over the marsh for half a mile or more on warm spring evenings.

Virginia Rail and Sora

Most members of the rail family are narrow-bodied, secretive birds, dwelling in freshwater marshlands. Although the Virginia rail is considered a gamebird, it is not often pursued. Its long toes and slim lines are perfect equipment for running off unseen through tall marsh grass, rather than flushing, when startled. Hiding in the rushes and reeds, this rail can dine on bugs and snails without leaving its safe haven. Even though it nests in Pennsylvania wetlands, it is elusive and only the persistent will glimpse the Virginia rail in its own element.

The sora is a somewhat more common bird, also inhabiting marshlands and stream margins. A bit of bog, supplied with cattails and grasses, is adequate for nesting. Although the sora swims well, and has flight strength adequate for long migrations, it often escapes danger by running through the wet undergrowth. Strangely long toes enable soras to run over lily pads, or "walk" underwater, clinging to aquatic plants with each step. Like the Virginia rail, soras have unassuming, reclusive habits. They quietly live their marsh-loving existence out of the way of most people.

The feet of rails are not continuously webbed like duck feet, but their swimming strength is enhanced by partial webbing on each toe — little flanges that push against the water with each footstroke, and fold backwards on the return to diminish resistance.

Common Moorhen

Once called the common gallinule, this oddly chicken-like bird inhabits fresh and coastal marshes. Requiring floating vegetation, on which it can "walk on water," moorhens tend to concentrate in the Pymatuning and Tinicum marsh areas of Pennsylvania. Wetland habitat is best for them in these regions.

The same type of unusually long toes that soras have enable moorhens to walk or climb through the densest wetland thickets. If flushed, they may resort to a stylized flight, really half running, as they flap their wings wildly just above the water's surface. They can fly purposefully when they decide to, steering with their trailing legs. In fact, they travel all the way to Central and South America when freezing water forces them out of northern bogs and sloughs.

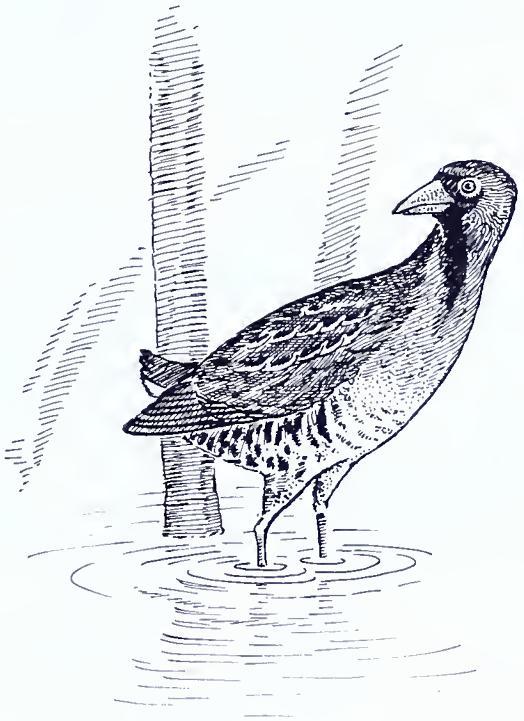
American Coot

Although closely related to moorhens, coots seem to prefer the company of ducks. They flock on the open water of large marshy bays or lakes, diving from the surface to feed on underwater plants and wriggly things. Like some ducks, they also can tip their heads down in the water for feeding, their dark tail ends pointing skyward.

Their adaptation to aquatic life is so complete that even their nests float, anchored to cattails to avoid drifting about. Sometimes called "mud ducks," coots are gamebirds. But they are not tremendously popular, being thought by many game connoisseurs to taste like their habitat — muddy.

Solitary Sandpiper

Called "solitary" because they are usually seen alone, these sandpipers are



Only those willing to wade and struggle through marshes are likely to spy the secretive sora. Although a relatively strong flier, it usually escapes detection by simply running through thick vegetation.

observed in Pennsylvania during their migratory travels. They are among the first to finish their nesting and begin moving southward, sometimes as early as late June and early July. During this annual sojourn, they stop along the shores of woodland streams and swamps. Wading in shallow water permits them to stir up bottom-dwelling aquatic life with their toes. The unwary prey rise to the water's surface, where they are quickly devoured. The solitary sandpiper bows gracefully to nothing in particular, in an accentuated version of the usual sandpiper bobbing. It flies in a skillful zigzag pattern low over the water. When frightened, it may either fly or dive, depending on the nature of the danger — diving from predatory birds, or flying to escape an earth-bound threat.

Greater Yellowlegs

Like other members of the sandpiper family, greater yellowlegs commonly are seen in Pennsylvania marshlands during migration. Unlike snipe, they do not use their long bills for mud-probing. Instead, the bill is pushed forward or side-to-side through the water, and used to nab small fishes and water bugs. They often fish in groups, aligned as they wade to form a living net.

The yellowlegs is a fairly large bird with a two-foot wingspan, and often calls attention to its flight with a loud cry. Its silhouette overhead shows long yellow legs trailing beyond the end of its tail.

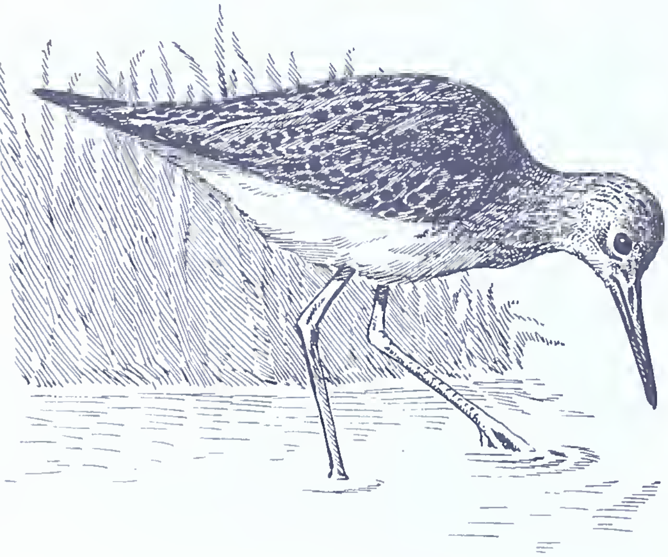
Pectoral Sandpiper

Another early migrant, the robin-size pectoral sandpiper may make its southward journey during any of the months of summer or autumn. It resembles the common snipe, but is more likely to be seen in the open. Mown wet meadows, muddy pools, and ponds on golf courses frequently attract this insect-eating bird as it passes through.

Common Snipe

Snipe resemble streamlined woodcock. Their slender bills are even longer, and are used for probing in the mud of marshes, and for catching diving beetles and crayfish. Snipe occasionally spend the winter in Pennsylvania, and may nest in damp pastures near bogs in northern counties. But they are most common during migration.

The courtship flights of male snipe are orchestrated by loud whistling sounds, resulting from air rushing through the spread feathers of their tails. In addition to migrational and courtship flight, snipe are able to dive and swim with ease. Under water, they propel themselves with feet and wings, usually to escape from airborne predators. Snipe were killed in huge numbers as a gamebird during the 19th century. They are scarce enough now that they are not commonly hunted, sportsmen preferring instead the more abundant woodcock, whose harvest is closely regulated.



The greater yellowlegs is a relatively large and conspicuous member of the sandpiper family. They are commonly seen wading in shallow water during spring and fall migration periods.

Short-eared Owl

Short-eared owls are more frequently seen by people than are other owl species. Their visibility is enhanced by their communal roosting and hunting, especially during bumper years for meadow mice. And they begin hunting in late afternoon, when enough light remains for even the less acute vision of humans to detect wildlife.

The low, fluttering flight of short-eared owls resembles that of harriers, and they hunt in the same areas of open fields and grassy marshes. The huge head and generally neckless appearance of the owl are distinctive. These owls nest in the northern reaches of both hemispheres. Pennsylvanians see them during periods of migration, and through the winter months.

Marsh and Sedge Wrens

Long-billed **marsh wrens** are seldom far from water. Tall marsh grasses, cattails, and reeds along meandering rivers or tidal estuaries are their home. The similar **sedge wren** may inhabit wet meadows and freshwater bogs, or scattered shrubs along marshy margins. Both species build their nests of and within marsh plants, weaving the stems to hang above shallow water. Aquatic insects and snails are the prey of the marsh wren, while the sedge wrens prefer more terrestrial bugs.

Males of each species may build multiple nests, festooning the marsh flora with their efforts, but using only one. Conflict between marsh wrens and red-winged blackbirds or least bitterns may result in the former puncturing the eggs of the other larger birds. Groups of either species of wren may form nesting colonies in particularly favorable locations. Unfortunately, areas of ideal habitat are diminishing, as wetlands are drained and development projects of humans expand.

Red-winged Blackbird

These gregarious birds may spend the winter in Pennsylvania or farther south, in roosts with thousands to millions of other birds. The striking color pattern of the males distinguishes red-winged blackbirds from the cowbirds and grackles with which they flock. Their yellow-edged, bright red epaulettes stand out in a crowd.

Adult red-winged blackbirds spend the nesting season in brushy marshes or upland weedy pastures, in more solitary family groups. They may raise two broods in a single season, feeding their young caterpillars and beetles, and helping to control populations of harmful insects. During this time, the males frequently choose a tall weed stalk in the open from which to sing repeatedly their familiar ''kong-ka-REE!'' Yearling males are closed out of the competition for territories, and usually while away an extra year in bachelor groups.

In the fall, the flocking begins again. Mixed flocks of blackbirds turn their attention to seeds and grain. They may subsist on waste grain in harvested fields or they may become agricultural pests.

Swamp Sparrow

During spring and summer, swamp sparrows move into Pennsylvania's wet meadows and open marshy areas for nesting. Here they wade in the shallows, hopping between weed clumps and cattails, feeding on floating insects. With the coming of winter, they may leave the marshes for weedy uplands, seeking a diet of seeds with other sparrows. Most leave the state and spend the winter in a more hospitable climate.

G. Lavanish

Ponds and Lakes

Areas of open water, however small, are grouped as ponds and lakes in this definition of habitat types. In Pennsylvania, most ponds and lakes are man-made. They range in size from farm ponds a few yards across, to the largest reservoirs, used for flood control, recreation, and water supplies.

The distinction between ponds and lakes, and marshes, as separate habitat types, is arbitrary at best. Most lakes have marshy margins or inlets, and thus these habitats tend to be complementary. Birds from both of these lists may be observed in the same areas. However, those listed as typical of ponds and lakes include birds more dependent on open water for feeding. Some examples are kingfishers, osprey, and eagles, which catch and eat fish; and the ducks which dive and feed underwater.

Common Loon

In very special parts of North America, the eerie songs of loons, like wild yodels and crazed laughter, punctuate the summer night. We think of loons as the embodiment of wilderness. Their striking black-and-white breeding plumage commonly graces isolated lakes of northern coniferous forests. Larger lakes and rivers of Pennsylvania sometimes provide respite from the rigors of northward spring migration.

Airborne loons fly strongly and swiftly in a straight line, but lack maneuverability. They have traded some of the finesse of controlled flight for diving gear. Strong legs, set far back under their bodies, propel their powerful webbed feet in deep dives. The quest for food may lure them to the dark silence of 200 feet below the water's surface.

Loons can choose the depth at which they float. Bobbing on the surface like a cork, they will begin to sink slowly, until only their heads remain in view. Such gravity-defying feats are possible because loons can control the difference in density between water and their own bodies. They can compress their plumage, expelling almost all of the air usually trapped among their feathers, determining for themselves when to float and when to sink.

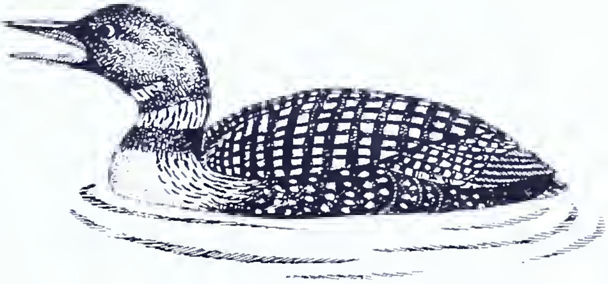
A loon is as specialized for lakes as a pontoon plane, and cannot take off from dry land. To launch themselves, they must run across the water 20 yards or more, pumping and pushing with their feet while furiously flapping their wings. Water also cushions their awkward, "belly-flop" landings. During spring migration, unexpected storms may force them to earth. On stormy nights, they are tricked by light reflection from street lamps into seeing pavement as ponds. On hard earth, their flying strength and swimming skills are useless. They must walk laboriously to the nearest body of water, or perish, as immobile as a deflated hot-air balloon.

Occasionally, common loons spend the winter, their silent season, in Pennsylvania. For nesting, loons require large peaceful lakes, undisturbed by motor boats and machine noise. Sadly, few states offer the haven they need.

Horned Grebe

Horned grebes move from freshwater to saltwater with the change in seasons. Small ponds and quiet

The sight of a migrating common loon resting on a Pennsylvania pond or lake represents a fleeting touch of wilderness for birdwatchers and the sound of its song is an especially rare treat.



backwaters attract them during the nesting season. During spring migration they may be seen on larger bodies of fresh water, in small loose flocks, before the pairs separate for nesting. For winter, most move to the coasts. Like the pied-billed grebe, the horned grebe is remarkably adapted to an aquatic life. The chicks can swim on the surface, and possess the techniques needed for diving from the day after they hatch. That doesn't stop them from hitching a ride on their parents' backs.

The "horns" alluded to by their name are tufts of contrasting feathers on either side of their heads, a fancy detail of their breeding plumage. Their striking reddish and black summer feathers made them a prime target of hunters for the millinery trade, back when women wore enormous bird-bedecked hats. Wings and sometimes whole skins of grebes and many other birds were considered appropriate decoration. This practice was stopped somewhat short of extinction for the grebes. Coastal oil spills are now the biggest periodic threat to grebe populations.

Tundra Swan

The fall migration route of tundra swans takes them through Pennsylvania on their way to the east coast. From breeding territories in the arctic reaches of Canada, they travel to the Chesapeake Bay for winter flocking and feeding. Once mated, a pair remains together for life. Pairs of tundra swans may be seen on lakes and reservoirs where they feed on water plants and rest during their long seasonal journeys. Both males and females are graceful, beautiful, snow-white birds, with necks as long as their bodies. When launching themselves from the surface of a lake, they cannot spring instantly upward like mallards. With very short legs and long wings, the swan's wing tips hit the water on each downstroke, and it must run 15 to 20 feet while flapping to ascend.

Although at home in the water, tundra swans swim only on the surface, and dive rarely when imperiled. Their long necks enable them to pull submerged parts of plants while their bodies remain on the surface. Or they may tip up like dabbling ducks, with the front half of their bodies momentarily submerged.

Young swans are grayish in their subadult plumage. Two or more years are required for them to attain maturity. The legend of "swan song," or dying call, is apparently based on fact. There is evidence that swans have made prolonged musical noises as they fell from the sky when shot.

Canada Goose

Canada geese are among the most abundant and best known waterfowl. Their black heads and necks, white cheeks and broad gray backs, the same for both sexes, are readily recognized. This is the bird most people think of when they envision flocks of southward-moving wild geese in V formation, foretelling the coming of winter with honking choruses.

These very sociable large birds spend most of the year in flocks. The young of the year remain with their parents throughout their first twelve months. Pairs remain together, and family groups are the nuclei of migrating flocks. Having their legs farther forward under their bodies than swans or most ducks, Canada geese easily land in fields for grazing, as well as on water. For lake-surface landings, outstretched neck and tail maintain balance while the goose "back-pedals" with his wings. Feet and fanned tail hit the water first, with stabilizing wings extended rearward. Once settled on the water, the goose seems imperturbable.

In many cities throughout the country, Canada geese have adapted to the ways of humans. Small populations are successfully maintained in city parks and zoological gardens, where the birds can even nest and fledge goslings. Wild populations nest in the northern

U.S. and Canada. In Pennsylvania, the best wintering areas for these glorious birds are in Crawford County.

Mallard and American Black Duck

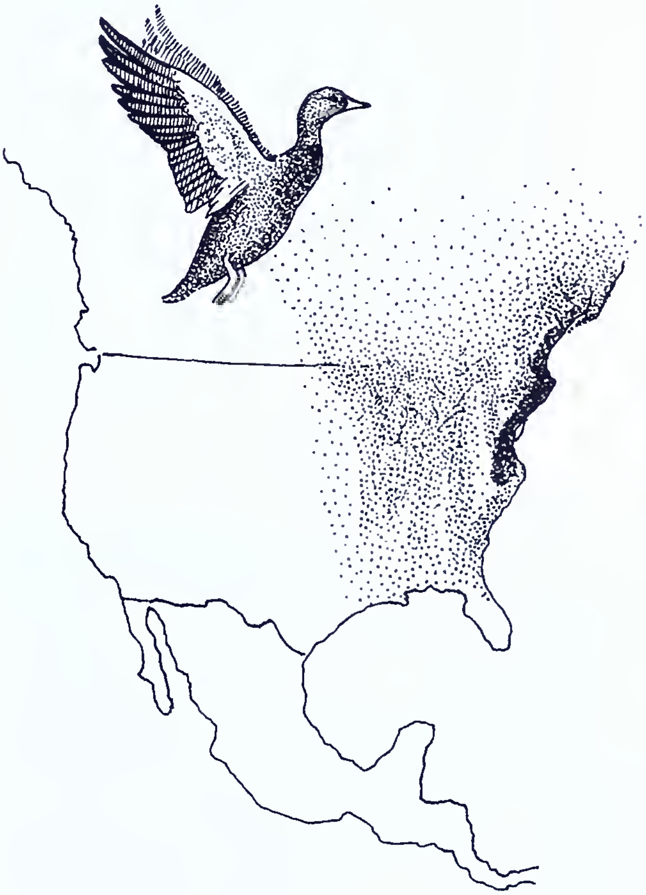
Most stocks of domestic ducks are descendants of mallards. This most abundant and widely distributed of Northern Hemisphere ducks nests and winters across three continents. The familiar green-headed drakes and less colorful hen mallards are at home on and around Pennsylvania's ponds and lakes in all months.

Black ducks are common throughout the eastern half of the United States and Canada. The Chesapeake Bay and nearby regions of the Delaware River and east coast are favorite wintering areas. Major corridors of black duck migration pass through the state.

Both black ducks and mallards are surface-feeding ducks. They share with other dabblers their tip-up feeding habits and ability to lift straight into the air without a preliminary run over the water. General characteristics of surface-feeding ducks were discussed with the previous habitat type (Marshes). During most of the year, the non-nesting periods, mallards and black ducks keep each other's company. Groups of three to five ducks are common sights, wheeling in low rapid flight with shallow constant wingbeats.

Nesting is a more private undertaking, and the responsibility solely of the hen. She frequently chooses an upland site, several hundred yards or farther from the nearest pond or stream. Or she may build her downy nursery in swamp grass or bank brush. As soon as the ducklings can walk, usually within the first day or so after hatching, the intrepid band lines up eagerly to march after mom to water. This first trek is rife with hazards: the last duckling in line is easy prey for weasels, hawks, or farm dogs. But the journey is necessary, taking the survivors to aquatic feeding grounds resplendent with insects and seeds.

Rapid growth of body and feathers leads to flight ability within about two months. The juvenile ducks then join flocks of adult males for fall feeding. Mallards migrate southward much later than pintails or teal, often remaining as far north as they can find open water. Many don't reach the central and southern states until early winter, following gradual travel from marsh to lake to open river. Black ducks are in no hurry either, the large flocks finally reaching their coastal resorts in mid-November.



Black ducks are found throughout the eastern half of the country, with a preference for coastal areas in winter. Extensive development of these areas by humans has adversely affected the black duck population over the years.

Wood Duck

Early in the 20th century, populations of wood ducks approached extinction. Draining of woodland ponds, logging, and excessive hunting all contributed to the woody's decline. The Migratory Bird Treaty Act of 1918 marked a new beginning for these strikingly beautiful ducks. Hunting limits, habitat conservation, and provision of man-made nest boxes all have added to restoration and maintenance of a large and healthy population of wood ducks.

Considered by many people to be the most beautiful of North American waterfowl, wood ducks grace Pennsylvania's forest ponds and sluggish streams year-round. Wintering birds are mostly limited to the southeast corner of the state.

Unlike some other surface-feeding ducks, a wood duck hen lays her eggs in a cavity, either in a hollow tree or in a structure provided for her. The home site, to which she returns faithfully year after year, may be up to a mile from open water, and 60 feet or more above the ground. When the one-day-old youngsters leave the nest, in response to their mother calling from the ground, it is an irreversible process. One by one, they leap at the nest entrance until they reach the opening, then jump out and tumble, remarkably unscathed, to the ground below. When her children have all emerged, the hen sets off for the nearest lake or stream, with a pod of cute fuzzy ducklings trotting along behind. Wood ducks are able hikers, much better equipped to wander overland, feeding on acorns, than most other waterfowl.

Many species of ducks do not "quack," of course, especially not wood ducks. The female has the louder voice, which is a distinctive, almost hawk-like scream. Drakes murmur sparrow-like sounds, as they fly low over the water in a flash of brilliant multicolored plumage.

Diving Ducks

Not all ducks feed by dabbling their front ends under water in search of shallow seeds and stems. Many have the ability to dive and swim underwater, in search of the succulent submergent plants or animals which comprise their diets. In general, the more vegetarian diving ducks, such as canvasbacks and redheads, are more frequently seen on bodies of fresh water, and are sought after during hunting season. All of these ducks, and especially goldeneyes, buffleheads, and oldsquaws, are able to swim and feed in salt water. A special gland in their bills permits them to eliminate excess salt.

Diving ducks are generally less gaudily colored than are their surface-feeding counterparts, usually plumed in somber gray, black, and white. Large feet and stubby, powerful, rearward legs make them strong swimmers, but terrestrial travel is a slow awkward waddle. The combination of aft leg positioning and smaller wings means that they must skitter over the surface in the transition from water to air. Because they cannot leap straight into or down from flight, diving ducks are limited to habitation of large bodies of water, with plenty of runway.

The erection of wood duck nesting boxes is a major reason this species has been rescued from the brink of extinction to the point where it is now the most common breeding duck in the eastern half of the country.

Appropriate nesting habitat for diving ducks is uncommon in Pennsylvania. Consequently, these ducks usually invade the state's flyways and waterways only during migration. Many winter in east-coast estuaries of the Delaware River and Chesapeake Bay.

Redheads in flight are frequently mistaken for mallards, with which they share body shape and shallow wingbeats. Their coloring is quite similar to that of the larger canvasbacks, even to the details of brownish-red heads. Although structured for diving, redheads also are able to utilize more marshy habitat than other bay ducks, where they feed on plants in very shallow dives, or engage in modified dabbling.

Canvasbacks are prized by hunters, and are a favorite, wary gamebird of the Susquehanna Flats. The long, sloping profile of their heads and bills led to the nickname "canard cheval," or horse duck. They are strong, fast fliers, seen in migration in characteristic V formation in the autumn skies.

Wooded ponds and open areas of swampy lakes are more attractive to **ring-necked ducks** than are coastal bays. This common migrant is popularly known as "ring-bill," because of the distinctly white outlining of its bluish-gray mandibles. The ring-bill marking is far more visible than the brownish feathers around the male's black neck for which it was named. When flushed, these ducks rise fairly readily from the water's surface with whistling wings. They also dive easily, and propel their underwater swimming with feet alone.

Lesser scaup gather in rafts of hundreds to thousands of birds on saltwater bays and large lakes during fall migration and feeding. The males of this small blue-billed scaup outnumber the females, although the sexes are difficult to distinguish, especially in flight. Lesser scaup are able to float at various levels of submergence, and dive instantly. They commonly feed during dives of five to eight feet, their bodies surrounded by a layer of silvery bubbles.

Common goldeneyes, like other diving ducks, require year-round open water. Their choices of winter habitat are limited, and they usually opt for coastal areas, where crabs and mussels are abundant all year. In flight, their wings create loud whistling sounds as the birds circle at treetop level, locating a landing site.

Buffleheads resemble diminutive goldeneyes, in their stark black-and-white plumage. Like many other diving ducks, they move from freshwater lakes to coastal saltwater bays from summer to winter. Able divers, they are also strong fliers, and can burst upward from the water's surface rather more easily than their larger cousins. The name "bufflehead" was shortened from "buffalo head," in reference to their heads being overly large and puffy relative to body size.

Three diving ducks often seen during spring and fall migrations through Pennsylvania are the canvasbacks, common goldeneyes and buffleheads. Most diving ducks nest farther north, but a few breed in the northwestern part of the state.

Migrating **oldsquaws** often possess plumage in some transitional stage of molt. This makes them hard to identify, their feather and color patterns unlike anything in the field guides. They have the pintail's long pointed rear-end profile, but their very stubby necks are distinctive. Northern Indians and traders likened the constant noisy but pleasant chatter of these gray-and-black ducks to that of old squaws, and the name stuck.

Common and Hooded Mergansers

Largest among inland ducks are the common mergansers. These long-bodied birds are structured for swimming and diving. Lifting their foreparts out of the water, they plunge headfirst, arching instantly downward. Underwater, they swim swiftly in pursuit of small fish or crustaceans, and grasp their slippery prey in serrated bills. They can also submerge slowly and gradually with hardly a ripple, like grebes and loons. But their submarine adaptations also require mergansers to run long distances over the water to launch themselves. This limits their activities to large ponds, lakes, and bays, with plenty of runway room. Pennsylvania is well within the wintering range of common mergansers, and on migratory routes as well.

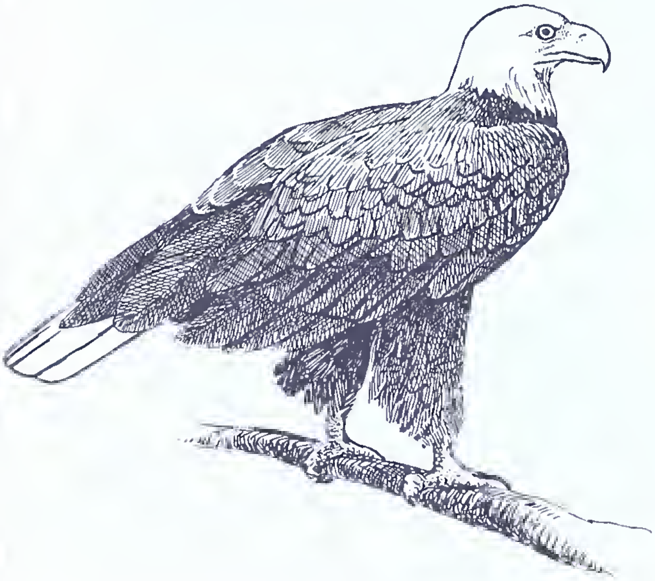
The hooded merganser is a closely related species, of similar habitat. These birds sometimes nest in Pennsylvania, in hollow trees which may be a considerable distance from water. The hooded merganser can rise from the water into flight more easily, without running and flailing. Feet and wings together propel them underwater in escape dives or in pursuit of fish. Insects and seeds supplement their diets.

Ruddy Duck

For some reason, the awkward antics of this small chunky duck strike people as being comical. More than sixty nicknames, most of them derogatory or funny, are applied to ruddy ducks: batter-scoot, booby coot (they frequent the company of coots), bumblebee duck, dumb-bird, stiff-tail, and many more. There are reasons for some of these names. The combination of very rapid short wingbeats and a stocky body makes them resemble fat bumblebees in flight. Drake ruddy ducks cock their fanned-out tails stiffly up over their backs when displaying to females.

Seemingly not streamlined, ruddy ducks nonetheless are accomplished divers. The positioning of their legs makes them helpless on dry land. But in water they can swim strongly, sink slowly, or dive quickly as required. Their stiff tails are rudders during submarine swimming, as they propel themselves to the bottom to feed on plants and mud-dwelling animals.

Pennsylvania is in a major migration corridor of ruddy ducks bound for wintering areas on quiet inlets of Chesapeake Bay. Small travelling flocks also congregate in large numbers on the Delaware River and in Tinicum



The majestic bald eagle, our national emblem, is one of the most popular species of wildlife among the general public. Once heading toward extinction, bald eagle populations are beginning to recover due to strong protection and various reintroduction projects being conducted by state and federal agencies.

Marsh, in the extreme southeastern corner of the state.

Bald Eagle

Our national emblem, the majestic bald eagle was once common in the skies and on high perches above coasts and waterways. Populations of bald eagles have declined, especially in the eastern U.S., for many reasons. Nesting habitat has been invaded by human settlements. The encroaching humans disturbed active nests, causing abandonment, and harassed and shot these magnificent birds in spite of protective laws. Eating large quantities of fish, eagles were ingesting enormous doses of pesticides, especially from carrion fish along polluted shores. Throughout the 1960s and 1970s, only one or two eagles fledged each year from three known nest sites in Pennsylvania.

The situation began to look brighter early in the 1980s, due to protection and actively helpful efforts of the Game Commission. The object of their labors is to increase the nesting populations, and insure a future for this important species in the commonwealth.

Bald eagles are believed to mate for life, and are known to return to the same nest for many years. The nests themselves are formidable structures, to which both members of the team add new sticks and miscellaneous stuff each year. Built high in a tree or on a natural or man-made platform, these amazing collections may be from five to seven or more feet across, twelve feet deep, and weigh over one ton. Eggs and young nestlings are dwarfed by these gigantic piles.

With a rich diet, largely of fish and carrion, the nestlings grow from three inches to three feet long in a few months. While they are small, the mother, larger of the pair, carries out most of the chores of feeding and shading her eaglets, while the male parent hunts for family dinner. He joins the mealtime melee later, tearing bits of flesh from the moment's catch and allowing the clamoring nestlings to take them from his bill. The immense nest becomes an exercise room as the eaglets clamber about and stretch their growing muscles. They must learn to fly on their own. Deciding one day that it is time, the young begin to hunt for themselves; the parents bring food near the nest but not to it. After two and a half months of growing and a few weeks of short practice hops, the eaglets are ready to "come and get it." This constitutes successful fledging.

Bald eagles are not bald. The heads of adult birds, at 4 or 5 years of age, are feathered in white, as are their tails. The "bald" refers to the stark contrast of white head to dark body.

Soaring high above mountain ridges, eagles leave their watery nesting and feeding areas for migration.

Osprey

The osprey is truly a fishing bird. Fine flight control and a five-foot wingspan allow it to fly low over lakes and saltwater, and hover with legs dangling, poised and ready to plunge. Not always able to grab the fish from the surface, the osprey may dive into the water from low flight. For an instant it may grapple with the catch, only the tips of back-folded wings protruding above the water. It pauses upon emerging, to arrange the fish lengthwise in its feet, parallel to its own sleek body. In this position, its dinner provides the least air resistance during the return flight to an habitual perch, where the osprey eats tail and all. Ospreys are strikingly beautiful black and white birds, graceful in flight and regal when perching.

Osprey populations plummeted during the mid-20th century. Pesticide residues from contaminated fish built up in their bodies, causing eggshell thinning and infertility. The Game Commission is attempting to reintroduce these remarkable birds, to encourage them to breed once again in Pennsylvania. Unfortunately, ospreys sometimes discover that fish hatcheries are a ready source of easy meals. This habit has caused them to earn disfavor among private hatchery operators.

Peregrine Falcon

It is difficult to choose one type of habitat and state specifically that peregrine falcons live there. In fact, this bird came so close to extinction in the mid-20th century that it could hardly be said to live anywhere in the continental United States. Pesticides had a devastating effect on the fertility and nesting success of falcons. By 1964, no peregrines were breeding in the eastern states.

The peregrine falcon is perhaps the most spectacular bird of all. A favorite among falconers, peregrines are able to stoop at possibly 200 miles per hour and strike their prey in flight.

Historically, peregrine falcons, also known as "duck hawks," were abundant and lived nearly the world over. Their amazing hunting skills made them a favorite among falconers. They were, in effect, both weapon and retriever for hunters in pursuit of gamebirds, in a relationship between man and bird that began over 1,000 years B.C. In the Middle Ages in Europe, princes chose the peregrine for sport hunting. Well-trained birds were extremely valuable, and elegantly cared for. The phrase "one fell swoop," taken from MacBeth, refers to the deadly accurate pursuing descent of a falcon from the sky. Its stoop, or hunting dive, is almost unbelievably fast, possibly up to 200 miles per hour for a few seconds until impact, feet first, with its prey.

Peregrine falcons formerly nested on cliffs above rivers throughout Pennsylvania. They were relatively common along the Susquehanna River, both nesting and migrating, and in many other areas near water. In these regions, food was plentiful and nests were isolated and safe. But traditional nesting cliffs were abandoned as the species declined due to pesticide poisoning and human influence.

Peregrine falcons have been successfully reintroduced into Pennsylvania and other eastern states through the efforts of a captive breeding program based at the Cornell Laboratory of Ornithology. Young birds hatched in this laboratory have been placed in former nesting areas and raised to become independent of their keepers. Nesting pairs of lab-hatched birds now live in the wild, in parts of the species' former range. Some falcons have adapted to city life, where ledges on tall buildings simulate cliffs, and pigeons are plentiful for food. Cities are free of wild predators of young falcons, enhancing successful fledging. The Game Commission has participated in the successful release of young peregrine falcons in Philadelphia.

With strict controls on pesticides and an active release program, a future for these beautiful and spectacular birds again seems possible. People should not begrudge them a few ducks and upland game birds. The impact of their hunting on game species is minimal, an insignificant price to pay for preserving this historically important and awe-inspiring falcon.

Spotted Sandpiper

The "teeter-tail" may be the best-known shorebird in the United States.

This popular name for spotted sandpipers stems from their incessant tail bobbing, up and down endlessly as they wade among the rocks near lake shores. Their breeding range takes in Pennsylvania, so you may see them on ponds and lakes in spring through fall, not just during the brief effort of migration.

The "spots" referred to in their name cover the breast and undersides of birds of both sexes, more so on the female. She nests in a grass-lined hollow on the ground near shore, after mating miscellaneously with several males. Active almost from the moment of hatching, young spotted sandpipers swim easily with their mothers. Adult birds dive either from the surface or from flight, whenever underwater escape is expedient. From people, they are more likely to flee into the air, with loud whistling cries and quick shallow wingbeats.

Gulls

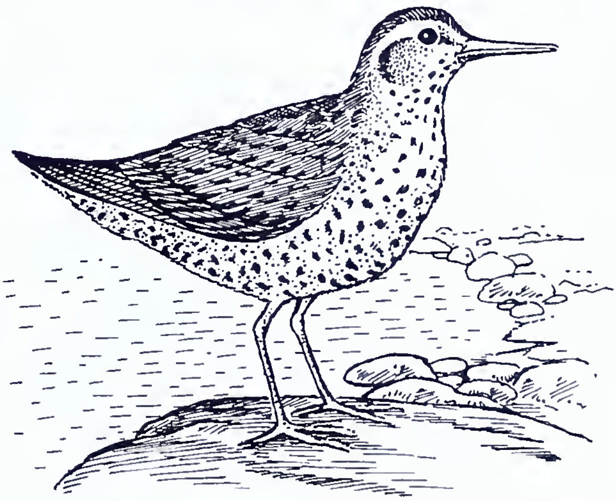
Although Pennsylvania lacks appropriate habitat for nesting gulls, several species migrate through the state or winter here. The most common species of gulls in the state are **herring gulls** and the smaller **ring-billed gulls.** Herring gulls especially, even though they are called "sea gulls," do not limit their activities to coastlines. Inland lakes, ponds, and rivers may attract them; they can drink either salt or fresh water. In fact, feeding opportunities at city dumps, sewage outlets into major rivers, and plowed fields lure them hundreds of miles inland.

The diets of herring gulls are by no means restricted to herring. They will catch for themselves many kinds of fish, but are just as likely to steal the catch from a coot. Food refuse, water creatures, earthworms, and rodents can make a meal. Gulls will also eat the eggs and young of other nesting birds, such as ducks and even other gulls. These food habits, and many systems of survival in the natural world, may seem strange or cruel to human observers. But they work well for the animals involved, and are in balance with the total environment.

Belted Kingfisher

The rattling call of the belted kingfisher, heard over lakes and clear streams, sounds more mechanical than musical. A true fishing bird, kingfishers hover over water or watch intently from a favorite bankside perch. As soon as a small fish comes close enough to the surface to be seen, down goes the kingfisher in a vertical, acrobatic dive. It emerges a few seconds later and flies off with its meal, which it will swallow head-first and whole.

The blue-and-white kingfishers are physically suited to their high-speed impacts with water and prey. With long, heavy bills and large crested heads, the birds look top-heavy. Their strongly built bills also are used, with their feet, for excavating nesting tunnels in banks of sand or clay. Although kingfishers are only about 12 inches long, they excavate horizontal burrows of three to ten feet or longer. Such a tunnel, lined with clean fish bones,



Spotted sandpipers nest throughout the state in suitable habitat and can be quickly identified by their tail-bobbing habits.

might be used many times. Diverging passages near the entrance may be inhabited by swallows.

Swallows of Ponds and Lakes

Three species of swallows commonly build their nests near open water. As is the case with other swallows (e.g., barn and cliff swallows), these birds are primarily insect eaters. Open water provides them an ideal opportunity for fancy swoops and rolls as they snatch insects from the air near the water's surface. All three are breeding residents of Pennsylvania. They all gather in huge flocks in staging areas, festooning fences and powerlines, before their fall migration southward takes place.

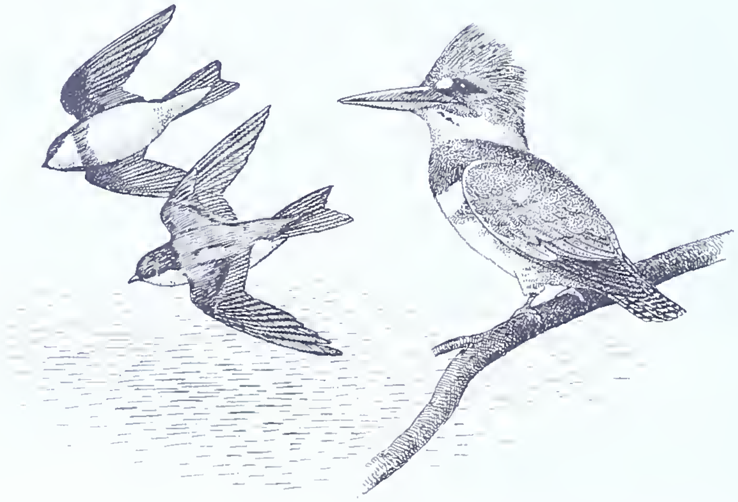
Open water, usually with marshy margins, will supply the requirements of **tree swallows.** This is the first species to migrate north in spring, a feat which is possible because tree swallows supplement their diets with seeds and berries. They will nest in natural cavities in trees or in nest boxes, preferring open fields to second growth or forest. They nest less densely than bank or barn swallows, still managing to congregate in areas of optimal habitat. Field guides say their green backs are distinctive, but on the wing they just look dark with white underparts. Their song, starting early in the morning and renewed after dark, is more musical than that of other swallows, and may aid identification.

Bank swallows are gregarious birds which neither accept nest boxes nor build structures from available materials. Instead, they excavate tunnels a few inches wide, extending two or three feet into sand or gravel banks. The tunnel openings are spaced only a few feet apart in colonies of hundreds of pairs. The excavation is begun with their bills, and continued with their small feet. The tunnel is aimed slightly upward at the end. This helps keep the nestlings high and dry.

Like bank swallows, **northern rough-winged swallows** excavate nesting tunnels in soft earth or sand. However, these unassuming brown-and-white birds live in solitary pairs rather than colonies. A single pair may elect to nest in a natural opening in a cliff or cave, in a drainpipe, or in the pre-existing tunnel of a kingfisher or ground squirrel.

Their name was derived from hooks along their wing feathers. These were considered a distinguishing feature back before the invention of binoculars, when people studied dead carcasses instead of live animals.

Three species which can be found along water impoundments throughout the state are the bank swallow (with the dark band across the breast), the tree swallow, and the belted kingfisher.



CHECKLIST OF PENNSYLVANIA BIRDS

Use this checklist of Pennsylvania's birds to record species you have seen. It is adapted from Merrill Wood's *Birds of Pennsylvania,* omitting only those species that very seldom stray into the commonwealth. The letters used in the checklist signify the relative number of birds that you are likely to find if you look in the appropriate habitat: A = abundant, C = common, U = uncommon, R = rare, and O = occasional (not present every year).

	SPECIES	SPRING	SUMMER	FALL	WINTER
____	Loon, Common	C	O	U	O
____	Loon, Red-throated	U		R	O
____	Grebe, Red-necked	R	O	R	R
____	Grebe, Horned	C	O	C	O
____	Grebe, Pied-billed	C	U	C	O
____	Cormorant, Double-crested	U	O	U	O
____	Heron, Great Blue	C	U	C	R
____	Heron, Green-backed	C	C	C	R
____	Heron, Little Blue	R	R	R	
____	Egret, Cattle	R	R	R	
____	Egret, Great	R	R	R	O
____	Egret, Snowy	R	R	R	
____	Heron, Tricolored	R	R	O	
____	Night Heron, Black-crowned	U	R	U	R
____	Night Heron, Yellow-crowned	R	R	R	
____	Bittern, Least	R	R	R	
____	Bittern, American	U	U	U	O
____	Ibis, Glossy	R	R	R	O
____	Ibis, White		O		
____	Swan, Mute	R	R	R	R
____	Swan, Tundra	C	O	C	O
____	Goose, Canada	C	R	C	O
____	Brant	U		U	O
____	Goose, Greater White-fronted	O		O	
____	Goose, Snow	U	O	U	O
____	Whistling-Duck, Fulvous			O	O
____	Mallard	C	C	C	C
____	Duck, American Black	C	C	C	C
____	Gadwall	U	O	U	O
____	Pintail, Northern	C	O	C	O
____	Teal, Green-winged	C	O	C	O
____	Teal, Blue-winged	C	O	C	O
____	Wigeon, Eurasian	O		O	O
____	Wigeon, American	C	O	C	R
____	Shoveler, Northern	U	O	U	O
____	Duck, Wood	C	C	C	O
____	Redhead	C	O	C	O
____	Duck, Ring-necked	C	O	C	O
____	Canvasback	U	O	U	O
____	Scaup, Greater	C	O	C	O
____	Scaup, Lesser	C	O	C	O

____	Goldeneye, Common	C	O	C	O
____	Bufflehead	C	O	C	O
____	Oldsquaw	U	O	U	O
____	Eider, King			O	O
____	Scoter, White-winged	U	O	U	O
____	Scoter, Surf	R		R	O
____	Scoter, Black	R		R	O
____	Duck, Ruddy	C	O	C	R
____	Merganser, Hooded	C	R	C	O
____	Merganser, Common	U	O	U	R
____	Merganser, Red-breasted	C	O	C	O
____	Vulture, Turkey	C	C	C	U
____	Vulture, Black	U	U	U	R
____	Goshawk, Northern	U	R	U	U
____	Hawk, Sharp-shinned	C	U	C	O
____	Hawk, Cooper's	U	R	U	R
____	Hawk, Red-tailed	C	C	C	U
____	Hawk, Red-shouldered	U	U	U	O
____	Hawk, Broad-winged	C	C	A	
____	Hawk, Rough-legged	U		U	U
____	Eagle, Golden	R		R	O
____	Eagle, Bald	R	R	R	O
____	Harrier, Northern	C	U	C	R
____	Osprey	C	R	C	O
____	Gyrfalcon				O
____	Falcon, Peregrine	R	R	R	O
____	Merlin	U	O	U	O
____	Kestrel, American	C	C	C	C
____	Grouse, Ruffed	C	C	C	C
____	Bobwhite, Northern	U	U	U	U
____	Pheasant, Ring-necked	C	C	C	C
____	Turkey, Wild	U	U	U	U
____	Crane, Sandhill	O		O	
____	Rail, King	O	O	O	O
____	Rail, Virginia	C	R	C	O
____	Sora	U	U	U	O
____	Rail, Yellow	O	O	O	O
____	Rail, Black	O		O	
____	Moorhen, Common	U	U	U	O
____	Coot, American	C	C	C	U
____	Plover, Semipalmated	U		U	
____	Plover, Piping	R		R	
____	Killdeer	C	C	C	U
____	Golden Plover, Lesser	R		R	
____	Plover, Black-bellied	U		U	R
____	Turnstone, Ruddy	O		O	O
____	Woodcock, American	C	C	C	O
____	Snipe, Common	C	O	C	U
____	Whimbrel	O		O	
____	Sandpiper, Upland	U	R	U	
____	Sandpiper, Spotted	C	C	C	O
____	Sandpiper, Solitary	C	O	C	
____	Willet	O		O	
____	Yellowlegs, Greater	C	O	C	O

____	Yellowlegs, Lesser	U	O	U	O
____	Knot, Red		O	O	
____	Sandpiper, Purple			O	
____	Sandpiper, Pectoral	C	O	C	O
____	Sandpiper, White-rumped	O		O	
____	Sandpiper, Baird's	O		O	
____	Sandpiper, Least	C	O	C	
____	Dunlin	U		U	O
____	Dowitcher, Short-billed	U		U	
____	Sandpiper, Stilt	O		O	
____	Sandpiper, Semipalmated	C		C	O
____	Sandpiper, Western	O		O	
____	Sandpiper, Buff-breasted	O		O	
____	Godwit, Marbled	O		O	
____	Godwit, Hudsonian			O	
____	Sanderling	R		R	
____	Phalarope, Red			O	
____	Phalarope, Wilson's	O		O	
____	Phalarope, Red-necked	O		O	
____	Gull, Glaucous	O			O
____	Gull, Great Black-backed	R	R	R	U
____	Gull, Herring	C	U	C	C
____	Gull, Ring-billed	C	U	C	C
____	Gull, Laughing	O		O	
____	Gull, Bonaparte's	C	U	C	U
____	Gull, Little	O		O	
____	Kittiwake, Black-legged				O
____	Tern, Forster's	O		O	
____	Tern, Common	U	U	U	
____	Tern, Least	O	O		
____	Tern, Caspian	U	O	U	
____	Tern, Black	R	O	R	
____	Dove, Rock	C	C	C	C
____	Dove, Mourning	C	C	C	C
____	Parakeet, Monk	R	R	R	R
____	Cuckoo, Yellow-billed	U	U	U	
____	Cuckoo, Black-billed	U	U	U	
____	Barn Owl,Common	U	U	U	U
____	Screech Owl, Eastern	C	C	C	C
____	Owl, Great Horned	U	U	U	U
____	Owl, Snowy			O	O
____	Owl, Barred	U	U	U	U
____	Owl, Long-eared	U	U	U	U
____	Owl, Short-eared	U	O	U	U
____	Owl, Northern Saw-whet	R	R	R	R
____	Chuck-will's-widow	O	O		
____	Whip-poor-will	C	U	U	
____	Nighthawk, Common	C	C	C	
____	Swift, Chimney	A	C	A	
____	Hummingbird, Ruby-throated	U	U	U	
____	Kingfisher, Belted	U	U	U	U
____	Flicker, Northern	C	C	C	R
____	Woodpecker, Pileated	U	U	U	U
____	Woodpecker, Red-bellied	U	U	U	U

____	Woodpecker, Red-headed	U	U	U	U
____	Sapsucker, Yellow-bellied	C	R	C	R
____	Woodpecker, Hairy	U	U	U	U
____	Woodpecker, Downy	C	C	C	C
____	Woodpecker, Black-backed			O	O
____	Kingbird, Eastern	C	C	C	
____	Kingbird, Western			O	O
____	Flycatcher, Great Crested	C	U	C	
____	Phoebe, Eastern	C	C	C	O
____	Flycatcher, Yellow-bellied	U	R	U	
____	Flycatcher, Acadian	U	R	U	
____	Flycatcher, Willow	U	R	U	
____	Flycatcher, Alder	U	R	U	
____	Flycatcher, Least	U	R	U	
____	Wood Pewee, Eastern	C	C	C	
____	Flycatcher, Olive-sided	U	R	R	
____	Lark, Horned	C	C	C	C
____	Swallow, Tree	C	C	C	
____	Swallow, Bank	U	U	U	
____	Swallow, Northern Rough-winged	U	U	U	
____	Swallow, Barn	A	A	A	
____	Swallow, Cliff	U	U	U	
____	Martin, Purple	U	U	R	
____	Jay, Blue	C	C	C	C
____	Raven, Common	R	R	R	R
____	Crow, American	C	C	C	C
____	Crow, Fish	U	U	U	U
____	Chickadee, Black-capped	C	C	C	C
____	Chickadee, Carolina	U	U	U	U
____	Chickadee, Boreal	O			O
____	Titmouse, Tufted	C	C	C	C
____	Nuthatch, White-breasted	C	C	C	C
____	Nuthatch, Red-breasted	U	U	U	U
____	Creeper, Brown	C	U	C	C
____	Wren, House	C	C	C	R
____	Wren, Winter	U	U	U	U
____	Wren, Bewick's	U	U	U	O
____	Wren, Carolina	U	U	U	U
____	Wren, Marsh	U	R	U	O
____	Wren, Sedge	R	O	R	
____	Mockingbird, Northern	U	U	U	U
____	Catbird, Gray	C	C	C	R
____	Thrasher, Brown	C	C	C	R
____	Robin, American	A	A	A	U
____	Thrush, Varied	O			O
____	Thrush, Wood	C	C	C	O
____	Thrush, Hermit	U	U	U	R
____	Thrush, Swainson's	U	U	U	O
____	Thrush, Gray-cheeked	U		U	O
____	Veery	U	U	U	O
____	Bluebird, Eastern	U	U	U	R
____	Gnatcatcher, Blue-gray	U	U	U	O
____	Kinglet, Golden-crowned	C	O	C	U
____	Kinglet, Ruby-crowned	C	O	C	U

____	Pipit, Water	U		U	O
____	Waxwing, Cedar	C	C	C	C
____	Shrike, Northern	O		O	O
____	Shrike, Loggerhead	U		U	O
____	Starling, European	A	A	A	A
____	Vireo, White-eyed	R	U	R	
____	Vireo, Yellow-throated	U	U	U	
____	Vireo, Solitary	U	U	U	
____	Vireo, Red-eyed	A	C	A	
____	Vireo, Philadelphia	R		R	
____	Vireo, Warbling	U	R	U	
____	Warbler, Black-and-white	C	C	C	O
____	Warbler, Prothonotary	R	R	R	
____	Warbler, Worm-eating	U	U	U	
____	Warbler, Golden-winged	C	U	U	
____	Warbler, Blue-winged	U	U	U	
____	Warbler, Tennessee	C		C	
____	Warbler, Orange-crowned	R		R	O
____	Warbler, Nashville	C	U	C	O
____	Parula, Northern	U	U	U	
____	Warbler, Yellow	C	C	U	
____	Warbler, Magnolia	C	U	C	
____	Warbler, Cape May	C		C	O
____	Warbler, Black-throated Blue	C	C	C	
____	Warbler, Yellow-rumped	C	O	C	R
____	Warbler, Black-throated Green	C	U	C	
____	Warbler, Cerulean	U	U	U	
____	Warbler, Blackburnian	C	U	C	
____	Warbler, Yellow-throated	R	R	R	
____	Warbler, Chestnut-sided	C	C	C	
____	Warbler, Bay-breasted	C		C	
____	Warbler, Blackpoll	C		C	
____	Warbler, Pine	C	C	C	O
____	Warbler, Prairie	C	U	C	
____	Warbler, Palm	U		U	O
____	Ovenbird	C	C	C	O
____	Waterthrush, Northern	U	U	U	
____	Waterthrush, Louisiana	U	U	U	
____	Warbler, Kentucky	U	U	U	
____	Warbler, Connecticut	O		R	
____	Warbler, Mourning	U	R	U	
____	Yellowthroat, Common	A	C	A	O
____	Chat, Yellow-breasted	C	C	C	O
____	Warbler, Hooded	C	U	C	
____	Warbler, Wilson's	U		U	O
____	Warbler, Canada	C	U	C	
____	Redstart, American	C	C	C	O
____	Sparrow, House	A	A	A	A
____	Bobolink	U	U	U	
____	Meadowlark, Eastern	C	C	C	U
____	Blackbird, Red-winged	A	C	A	U
____	Oriole, Orchard	U	U	R	
____	Oriole, Northern	C	C	C	O
____	Blackbird, Rusty	U		U	U

____	Grackle, Common	A	A	A	U
____	Cowbird, Brown-headed	A	C	A	C
____	Tanager, Scarlet	C	C	C	
____	Tanager, Summer	O	O	O	
____	Cardinal, Northern	C	C	C	C
____	Grosbeak, Rose-breasted	U	R	U	O
____	Grosbeak, Blue	O	O	O	
____	Bunting, Indigo	C	C	C	O
____	Dickcissel	R	O	R	O
____	Grosbeak, Evening	U	O	U	U
____	Finch, Purple	U	U	U	U
____	Finch, House	C	C	C	C
____	Grosbeak, Pine	R		R	R
____	Redpoll, Hoary				O
____	Redpoll, Common	U		U	U
____	Siskin, Pine	U	R	U	U
____	Goldfinch, American	C	C	C	C
____	Crossbill, Red	R	O	R	R
____	Crossbill, White-winged	O		O	O
____	Towhee, Rufous-sided	C	C	C	O
____	Sparrow, Savannah	C	U	C	R
____	Sparrow, Grasshopper	C	C	C	O
____	Sparrow, Henslow's	R	R	R	
____	Sparrow, Sharp-tailed	O		O	O
____	Sparrow, Vesper	C	U	C	R
____	Junco, Dark-eyed	C	U	C	C
____	Sparrow, American Tree	C		C	C
____	Sparrow, Chipping	C	C	C	O
____	Sparrow, Field	C	C	C	R
____	Sparrow, Harris'	O		O	
____	Sparrow, White-crowned	U		U	R
____	Sparrow, White-throated	A	R	A	C
____	Sparrow, Fox	U		U	R
____	Sparrow, Lincoln's	U		U	O
____	Sparrow, Swamp	U	U	U	U
____	Sparrow, Song	C	C	C	C
____	Longspur, Lapland	U		U	U
____	Bunting, Snow	U		U	U

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